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EDITORIAL

PRECONCEIVED NOTIONS AND THE COCONUT BEETLE

THE appearance of the swallows in England at the beginning of the spring was at one time believed by many to be the result of their awakening from a hibernating period in the woods or even from under the water in ponds. So keen a naturalist as Gilbert White records that on an occasion he had the coppices in the neighbourhood of his home beaten out to see if he could disturb such birds from their winter sleep.

A somewhat similar fallacy exists in Ceylon with regard to the coconut beetle (*Oryctes rhinoceros*). Its appearance on coconut estates is frequently being attributed to its breeding in coir refuse dumps in the neighbourhood. The example of Gilbert White's method of testing his theory is recommended to those who believe the coconut fibre dumps to be the places from which the beetles come when they appear abroad. It would be a good plan for those who have coir refuse heaps in proximity to estates where the beetle is a pest to have these heaps carefully examined for beetle larvae and pupae. Preconceived notions are always of the greatest danger to the establishment of truth. One of the earliest principles that a scientific investigator has to learn concerns the value of a preconceived notion, if it does not rigidly stand the test of the severest cross-examination, it has to be absolutely dropped and never allowed to influence the mind in arriving at a conclusion.

This preconceived notion that the coconut beetle breeds in the coir dumps has so far not been supported by unprejudiced investigation and until it is the breeding ground of the beetle must be looked for elsewhere.

From all sides come reports of an increase of this enemy and the damage done by it on coconut estates. It behoves all interested then to take every precaution to try to bring it under control. The larvae and pupae of the beetle can be found in decaying organic matter such as fronds, fallen coconut tree heads and trunks and other plant material, including dead cover crops. The transference of such substances into a fertilising agent by letting the processes of decay do their work should therefore be done under precautions that will prevent the multiplication of the beetle. Criticism of one's neighbours' fibre dumps is not such a precaution. The prevention of decaying vegetable matter from becoming beetle propagating centres is the duty of all, both upon and near coconut estates. If such material is not required the sooner it be destroyed by fire the better but on the estate itself it will be desired to transfer it into humus rather than into ashes. This should be done by entrenching it in pits sufficiently deep to allow of its being covered by about a foot of sand or soil free from humus. The covering of the material is of the greatest importance. On some estates it is the custom to simply place the rubbish in trenches and perhaps to sprinkle a fertiliser upon it. Neither of these methods without covering is sufficient. The admixture of a fertiliser with the leaf-fall gives an excellent method of improving the estate but if the material be left uncovered the fertiliser may not be a preventative of beetle multiplication. Rainfall may wash the decaying fronds and other material free of the fertiliser and leave nothing objectionable to the beetle. The covering of the trenches with soil prevents to a large extent such action from taking place and thus leaves the material noxious to the beetle eggs and larvae. A similar precaution should also be taken with the use of green manures. If these be ploughed in with the addition of a fertiliser, it should be possible to render the soil uncongenial to the beetle.

The undesirable increase of the beetle and the necessity of taking precautions to prevent its spread are of sufficient importance to warrant serious notice and are therefore the reasons for making them the theme of this paragraph.

THE MANGO IN CEYLON

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1. CEYLON TYPES OR VARIETIES

FEW fruits, if any, have in India the reputation and history of the Mango (*Mangifera indica*) considered by De Candolle to have been in cultivation for many centuries, and certainly as far back as any dependable records go.

A native of India and the eastern tropics, its cultivation reaches to all tropical regions of the world, but the true home of the mango with its numerous varieties and hybrids is undoubtedly India.

Sturtevant in his "Notes on Edible Plants" gives Tropical Eastern Asia as the home of *Mangifera indica* and regarding the distribution of this fruit he records that the mango was introduced to Jamaica in 1782. In 1880 several fruitful and superior varieties were growing in the Botanic Gardens in Trinidad, and at Cayenne it was introduced at the beginning of the present century. Its introduction into Brazil was more ancient as the seeds came thence from Barbadoes in the middle of the eighteenth century, and in Martinique, by grafting, a dozen distinct varieties of excellent quality have been established. In Mauritius a number of varieties are established, whilst the tree is now grown to a limited extent in Florida also.

Although the fruit is found in the markets, the bazaars, and in the villages of Ceylon in large numbers during its season, the quality is invariably extremely poor and the fruits are usually from seedling trees. The few really good fruits to be found occasionally in the markets are generally those imported from India from grafted or enarched trees, but these in most instances suffer from the fact that the fruit is picked in too unripe condition and this detracts from the true flavour of a first-class mango.

There are in Ceylon about five types of the common mango. These are (i) the "Jaffna" mango which is of good quality when well grown, large, oval in shape, and not unlike the "Alphonso" of India; (ii) the "Rupee" mango, or Pol-amba a large globular-shaped fruit of good flavour, in great demand but never available in any large quantity owing to its shy fruiting habit; (iii) the "Parrot" mango or Gira-amba, a medium-sized fruit with broad marked beak and of a slightly acid but pleasant

taste; (iv) the "Bombay" mango or Baita-amba, a round and compressed fruit, juicy, yellow when ripe, of average quality and probably the commonest variety to be found in the Ceylon markets, and (v) the "Honey" mango, or Mi-amba, a somewhat small round fruit, of acid and poor flavour resembling turpentine rather than honey.

There are also wild varieties. The Etamba bearing a small oval fruit with scanty juicy pulp of a tart flavour, and though occasionally eaten, it is very unpalatable. The Puhuamba is another variety with very small fruit, acid but sweet flavour, and seedless.

The Ceylon mangoes generally leave much to be desired, yet many parts of the Island are suited to the proper cultivation of really good varieties and much more could be made of the mango than has been the case up to the present. The semi-dry regions of Ceylon and the dry regions also where irrigation is available are the areas most suited to this fruit though in certain districts of the wet zone varieties of the "Jaffna" mango have been observed to give quite useful crops. A pronounced dry season is, however, a very necessary climatic requirement and the reasons for this will be indicated later. Established fruit orchards worked on any up-to-date lines do not, as such, exist in Ceylon, except in rare instances. Individual enthusiasts have, however, of late years realised the necessity of an improvement and increase in fruit cultivation and production, and the opening up of small areas here and there is on the increase.

Of the mangoes common to Ceylon the "Rupee" and certain varieties of the "Jaffna" only are worth persevering with. The "Rupee" is a very fine fruit both for size and flavour, and careful experiments are necessary to ascertain if its shyness in fruiting cannot be improved by a selection of the best and the highest yielders. Its transfer by budding or enarching to a suitable stock, as European horticulturalists have similarly improved the temperate region fruits, wants to be tried.

2. INDIAN TYPES OR VARIETIES

The Indian mangoes are generally considered to belong to one species, *Mangifera indica*, though other species have doubtless entered largely into the composition of most of the cultivated forms. The number of types, sub-types, varieties, and sub-varieties are legion and present the problem of a cross-word puzzle. Indian nurserymen have undoubtedly a penchant for creating a bewildering number of new varieties from any tree that yields a fruit of superior quality, and this has led to synonymy and confusion.

The numerous requests for information on fruit growing received at Peradeniya are invariably preceded by the query as to what are the best imported varieties or types of particular fruit trees to grow. At the outset the first question to decide is whether a sufficiently good type of tree is available locally from which to propagate, or whether to import the trees required.

There must at the present time be a considerable number of imported grafted trees of good type in the Island. Many were imported in past years through the assistance of the Ceylon Agricultural Society, and of later years through the Central Seed Store, Peradeniya.

The varieties available from India on import are numerous but unfortunately a large number are worthless. Indiscriminate importations are to be avoided and plants of known good variety only should be secured. The following may be recommended:

(a) "Alphonso."—This is the leading variety of a group that keeps well and is probably the most widely cultivated mango in the Bombay Presidency. It bears fruit of average size and excellent flavour, the skin is thin and the pulp is reddish in the middle to pale-yellow on the outside, and the average weight is 14 oz.

(b) "Bangaloora."—A long-fruited variety and above the average in size, slightly tinged with red at the extremeties, the flesh reddish, very sweet and of good flavour. At Heneratgoda Gardens a five-year-old tree of this variety produced a fruit weighing 28½ oz.

(c) "Batli" or "Batlee."—A variety common in Bombay where they come into the markets from middle of May till end of June. It is a heavy, luscious fruit, with deep orange flesh, and the fruits average 14 oz.

(d) "Dilpasand".—A Bombay variety of good size fruit often 20 to 22 oz. in weight. The flesh is canary yellow, fibreless, with thick pulp and a flavour slightly acid, but delicious. This should not be confused with the South Indian "Dilpasand," as the latter is not so delicately flavoured and resembles more the "Totipuri" than the round "Dilpasand" type.

(e) "Fernandin."—A highly-prized variety with thin skin and flesh of bright yellow and thick consistency. A very superior fruit averaging 16 oz. but often 20 oz. or more in weight.

(f) "Koothathath."—A variety very similar to "Bangaloora" but with greenish colouring, yellow when ripening. Fruits are large, averaging 18 oz. each, the flesh being light in colour, fibreless, and of good taste and flavour.

(g) "Mulgoa."—A very fine mango of the Madras type and grown in abundance in Bangalore. In America this variety, the first of the Indian grafted trees to fruit there, does not fruit freely, but in the eastern tropics little fault can be found as to its fruit-yielding capacity and both in appearance and taste the fruit is exceptionally good. The skin is thin, the pulp pale-yellow, and the average weight of the fruit about 16 oz.

(h) "Piari."—This variety is of the type considered by many to produce the finest mango in India, but it is of rather poor keeping quality. The skin is moderately thick, the flesh bright yellow to orange, of fine texture, firm and juicy and of excellent flavour. The average weight of the fruit is 14 oz.

(i) "Peter Pasand."—A fruit of average size and of excellent taste and flavour. The skin is thin and separates easily from the pulp. Though not so well known as the foregoing varieties, can be well recommended, the fruits averaging 14 oz.

There are of course numerous others but those described are the better known of the Indian varieties. The western tropics and other parts also have their particular varieties or types, the more prominent of these being "Julie," "Peters," and "Pere Louis" of the West Indies, not omitting the famous No. 11 of Jamaica, and the equally famous "Sundersha" of Florida, the "Caraboa" and "Pica" of the Philippines and the "Gundoo" and "Sabre" among others of South Africa.

3. SOILS

The mango as with most other fruits thrives best in a good loamy soil but it is adaptable to a wider range of soils than many fruit trees. An essential requirement is that the soil should be well drained. The laterite and cabooky soils of many parts of Ceylon are suitable, though a good loamy soil is best since this produces and supports good yields and excellence of fruit. The red laterite soil of parts of India is well known to be most suited to mangoes. A shallow soil of hard rock or pure sand is not a suitable one since the mango is a deep-rooted tree, but a sandy to sandy loam soil with some depth will give excellent results provided fertilisers are applied fairly liberally and such soils in Southern Florida have proved most satisfactory. A clayey soil, provided it is well drained, seems to be a good soil for mangoes also, but the main requirements are obviously depth of soil and good drainage. The fine avenue of mango trees at the Botanic Gardens of Rio de Janeiro are of large dimensions and of great age but according to Dr. Willis, (formerly Director of these gardens, and at one time Director of the gardens at Peradeniya) these never mature any fruits owing to the original error of planting the trees on low wet ground, though others planted on higher ground in the same gardens fruit freely and regularly. Good drainage cannot therefore be too strongly emphasized.

4. CLIMATE

Most tropical areas are suitable for the mango tree and in Ceylon it will thrive from sea level to 2,000 feet and will grow, but is scarcely fruitful, at elevations up to 4,000 feet. Though the tree grows well in humid localities subject to rain at all seasons, it cannot ordinarily be successfully fruited in such since a pronounced spell at time of flowering and setting of fruit is essential.

Localities with an annual precipitation of 50 inches, or more if it does not coincide with the flowering season, are conducive to satisfactory results, and where irrigation facilities are available it will succeed with less rainfall than this. The mango is in fact better suited to irrigated areas than otherwise since its moisture requirements are peculiar in that the effect of rain or even humid atmospheric conditions at time of flowering and setting of fruit are specially injurious by its interference with pollination. The commonest cause of crop failure at Peradeniya and in other moist regions is generally considered to be due to wet or damp weather at time of flowering. In irrigated areas the trees need to be irrigated till their fourth year, but after the fourth year watering is not necessary unless the tree actually shows signs of wilting.

5. PROPAGATION

The predominant method of propagation of this fruit at the present time in India is by enarching, but propagation by means of budding is also adopted, and in the western tropics by seed-sowing also. Propagation by cuttings has not been successful to any degree. With regard to the seed it should be noted that there are two types, firstly, the mono-embryonic type with seed containing only one embryo which is produced by a sexual process and is not therefore to be depended on to produce true progeny unless it came from a true bred parent stock which is usually not the case. The second type is poly-embryonic which contain several embryos arising as buds from the outer covering of the seed and are in consequence the equivalent of a bud or a graft of the parent and therefore represent that type.

The latter type of seed is more frequently found in the western than in the eastern tropics. In the eastern tropics the first type predominates.

The systems of enarching and budding are well known to insure uniformity of fruit, early bearing, and productiveness in the majority of fruit trees, and it applies to the mango also. For this reason these methods of vegetative reproduction are advocated for growers in Ceylon, and the question of a suitable stock or stocks have to be considered. At the present moment little or no definite information is available and propagation in

the east has been almost entirely restricted to enarching. The common mango (*Mangifera indica*) the Amba, and the Ceylon wild mango (*Mangifera zeylanica*) Etamba, would as far as present experiences go, meet the case. The former is cultivated in most parts of the Island and has a wide range of climate and elevation, being suited to both dry and wet zones and to an elevation of 4,000 ft. The latter is a very large tree of robust habit found in the low-country forests of both moist and dry regions.

Little can be said at the moment as to the probable influence of stock on scion, as very few reliable trials have been made either in India or elsewhere, but it is stated that the position of the scion on the stock influences the vigour of the vegetative growth of the scion and the age at which it flowers.

The Agricultural and Co-operative Gazette, Nagpur, Vol. IX, states that Bombay grafts were seriously affected by frost each year when growing at Pagara but when such were grafted on the wild Pachmari seedlings common to the Pachmari hills the resulting trees, without deterioration of quality, were quite frost resistant.

Both statements indicate a definite physiological influence of stock on scion and the qualities of the local and the wild mango as suitable stocks in respect to their root system and other probable advantages might be taken for granted at the present stage.

The enarching mode of propagation is the most common one employed for mangoes but unless grafting material is plentiful the method is an expensive one. Patch or shield budding on the other hand conserves material to a large degree and though more difficult, is successful if properly carried out, and it is preferable generally.

In the raising of stock plants, seeds should be selected from sound healthy and vigorous trees. The seeds germinate readily when fresh but lose their vitality if kept for long and should therefore be sown at once. The seeds should be planted at a depth of three to four inches and eight to ten inches apart if the seedlings are to be lifted into pots before budding, but sixteen to eighteen inches apart if budding is to be done in the nursery bed. A difficulty is invariably experienced in lifting the larger seedlings for potting purposes owing to the tap root system of the mango but this can be remedied to some extent by making the seed-beds on shallow soil or on a foundation of brick material.

Seedlings should be ready for budding when they attain the diameter of half an inch at a few inches above the ground, but larger seedlings if available are preferable. The best time for budding is usually towards the end of the monsoons but they can

be budded at other times also, according to the receptive condition of the stock, that is, when the bark lifts easily, usually during the periodical flushes of growth which last for several weeks, and patch budding, either by the square or rectangular patch is recommended.

The actual operation of patch budding might here be described and is as follows: Assuming the bark of both stock and scion lifts easily, a square or rectangular piece of bark bearing a bud from the scion should be taken out, of approximately 1 inch long by $\frac{3}{4}$ inch wide, and transferred into the stem of the stock from which a similarly shaped piece of bark has been removed. A small quantity of grafting wax is then smeared over the edges of contact and the bud with its shield firmly tied with budding tape or strands of bark. The stock should be budded at six inches from the ground, but this can be varied according to requirements and the size of the stock. All cuts should be clean ones and the operation carried out as quickly as possible so as to prevent the cambium surfaces of the stock and scion being damaged or dried by exposure. During the operation shady conditions are preferable and, if in the open, temporary shade should be afforded till such time as the buddings are well established.

A good grafting wax is made of a mixture of beeswax 2 parts, tallow 1 part, and resin 1 part. The two former should be melted, adding the resin in a well-powdered state and the whole stirred well. Ordinary white cotton cloth serves the purpose of a good budding tape and can be cut into various lengths and widths according to the size of the stock budded, and for average-sized stocks, strips 15 inches long and 1 inch wide are the best. Soak the budding tape in the grafting wax while it is hot and hang up to dry for an hour or so, afterwards winding the tape or cloth around a stick. The waxed tape will thus keep of suitable consistency for a long time.

After 14 to 18 days from budding the bandages should be removed and if the operation has been a successful one the bud sheath will show a healthy green appearance similar to that at the time of budding. The stock should then be notched at a point five or six inches above the point of the budding to arrest the flow of sap to the head of the stock and the bandages re-tied very lightly, but on this occasion, leaving the dormant bud exposed. The budding tapes should be finally removed when the bud begins to grow, a period that can vary from four to ten weeks from budding. At this time the head of the stock can be cut off at the point previously notched to allow all the vigour of the stock plant being forced into the newly-attached bud.

Budwood should naturally be selected from healthy vigorous trees and of the best fruiting qualities available. The bud selected should be from wood of the second or third flush below the growing point and the precaution should be taken, should the leaves not have fallen, of pinching off the leaf blades some two or three weeks beforehand from the shoots required for budding, this allows the leaf-stalks to drop and leaf-scars to heal over before the wood is required for budding.

6. CULTIVATION

Soil and climatic conditions have already been discussed and having selected a suitable site, good holes at least 3 feet in width and 3 feet in depth should be prepared. The holes should be 30 feet apart each way. A good dressing of well-decayed cattle manure should be incorporated with the soil when refilling the holes.

The mangoes must be considered the main crop of the plantation, though interplanting with catch crops for the first three or four years can be entertained.

The plants will require shading and watering for the first few weeks and permanent staking is required to prevent damage by wind. Attention during the first three or four years should be devoted to the encouragement of good healthy growth with a strong robust framework. A periodical dressing of well-decayed cattle manure on the approach of the monsoons, with a forking up of bed surface and a mulch of leaves, grass cuttings or other material just prior to the dry seasons will materially assist in this. From the fifth year onward the object is to induce fruiting and a change of manure is required, since cattle manure is not generally considered an entirely suitable manure at the flowering and fruiting stage. Heavy dressings of cattle manure upset the process of normal formation of flowers, and fruit production is postponed. Manuring therefore should be much lighter at this stage and the phosphoric acid contents of such manures as are given should be increased. A useful manure mixture for trees at the flowering and fruiting stage is recommended by the Acting Government Chemist, Peradeniya, as follows:

Sulphate of Ammonia	½ part	5-6 lb. per tree
Superphosphate	2 parts	
Steamed Bonemeal	2 ,,	
Sulphate of Potash	2 ,,	

in addition to small dressings of cattle manure or leafmould.

7. PRUNING AND THINNING

The fruit-bearing qualities of the mango vary greatly and much is doubtless involved in the principles of pruning or thinning adopted. These have not yet been worked out with any

accuracy. Unfavourable weather conditions in the direction of heavy rains, cold conditions, and even excessive heat if accompanied by hot dry winds at time of flowering are seriously adverse to the tree. Overbearing and exhaustion following a heavy crop are other difficulties to contend with, but these can be prevented or modified to some degree by the thinning of the crop in the early stages, and subsequent thinning out of the growing shoots. The mango is, like certain other fruit trees, subject to the peculiarity of alternating fruit years and prevention of overbearing from the early years can assist in overcoming this disadvantage.

According to investigations to date unfruitfulness in the mango is not due to defective mechanism of pollination. Popenoe, in a very thorough study of the subject of the pollination of the mango, concludes that mango sterility is due to climatic conditions which appear to favour vegetative growth and not reproductive growth. Root pruning can usefully be employed on unproductive trees, such operations tending to the formation of fruit buds which require to be encouraged by some check to the vigour of the tree.

Speaking generally, pruning, thinning, or root pruning, whichever is applied, means the checking or suppression of certain parts of the tree, either vegetative growth or root growth, in order that additional energy may be directed towards building up the tree structure, or when growing too freely to flower or fruit well. The reduction of vigour by restriction of root supply, usually by means of root pruning, induces profusion of flowers and consequently the larger possibility of yield of fruit.

8. PESTS AND DISEASES

Of the insect pests common to the mango the Government Entomologist has afforded the following information in respect to the chief of its enemies:

Fruit pests.—The most important insect pests of mango fruits are the mango seed weevil (*Cryptorhynchus mangiferae*) and fruit flies (*Dacus* spp.).

1. The seed weevil is found in most parts of the world where mangoes are grown. The weevil lays its eggs in the fleshy portion of the young fruit and the grub on hatching bores into the seed and passes the remainder of its life inside the seed where it changes into the pupa and finally into the weevil. Portions of the pulp may become rotten, and infested fruits may drop prematurely. The presence of more than one grub in a young seed may result in its entire destruction, but usually the seed is not injured seriously enough to prevent germination. The weevils may remain in the seed until after the fruit has been

eaten and the seed has been discarded. Since this pest passes the whole of its early life inside the seed and there is often no external evidence of injury there is no practicable method of control except the collection and destruction of all fallen fruit.

2. Fruit flies are occasionally serious pests. The eggs are laid in the fruit and the maggots after destroying the fruit emerge to pupate in the soil. Poisoned baits can be used to attract and kill the flies before they lay their eggs. The usual bait recommended is a mixture of 6 lb. of cheap sugar and 6 oz. of arsenate of lead dissolved in 8 gallons of water. This bait can be sprinkled on to the leaves or exposed in tins or bottles hung from the branches; strips of cloth or lamp-wick can be hung outside the vessels with one end in the liquid. The collection and destruction of fallen fruits will also help to control these pests.

Leaf-eating pests.—The young leaves are attacked by various caterpillars and beetles which can be controlled by spraying with arsenate of lead used at the rate of 2 lb. in 50 gallons of water, or 1 oz. in 12 pints.

Plant-sucking bugs, including scale insects.—These can be controlled by spraying with concentrated lime and sulphur used at the rate of 3 oz. in every 1 gallon of water, or about a 2 per cent solution. This is a combination insecticide and fungicide and may also act as a deterrent to many leaf-eating insects.

Of mango diseases the Acting Government Mycologist gives the three main fungoid diseases common in Ceylon and the preventive measures, as follows:

Mildew.—The mango mildew (*Oidium* sp.) occurs at high elevations and attacks the new leaves produced after wintering. It is a white powdery mildew and can be checked either by dusting with sulphur or spraying with some sulphur compound. A convenient spray compound is a proprietary lime-sulphur spray known as "Sulfinette." This liquid is convenient to use and does not clog the nozzles of sprayers. The spray employed should consist of a 1-2 per cent solution in water. The trees should be sprayed or dusted during the wintering period and two applications should be made at intervals of one week before the new season's foliage emerges. It is hardly worth while to dust or spray later since any damage already done cannot be rectified.

Red Rust (*Cephaleuros parasiticus*).—This is an alga which forms orange-red to rusty brown patches generally on the upper surface of the leaves. *Red Rust* is essentially a disease of weak plants and the first consideration therefore is to improve the vigour of the trees by cultivation and manuring. On small trees the alga can be attacked directly by spraying with Bordeaux mixture. Spraying should be done before the orange fruiting

patches appear on the leaves because at this stage the spray will not wet the parasite. The following mixture if added to the Bordeaux will make it more adhesive in wet weather:

Washing soda	1 lb.
Resin (common resin or colophony)	2 lb.
Water	1 gallon.

Boil the water, then add the soda. When dissolved add the resin and boil for about one hour stirring continually. Add this, when cool, to the Bordeaux mixture at the rate of 1 gallon to every 24 gallons of Bordeaux.

Anthracnose.—This is a disease which affects the young leaves, twigs and fruits and is caused by the fungus *Gloeosporium Mangiferae*. The fungus attacks the young leaves and twigs forming small dark areas and causes the shoots to die back. On older fruits black spots of various forms occur which are usually sunken and may coalesce to form large diseased areas and cause rotting of the fruit. The fungus can be checked on the shoots by cutting off and burning the twigs and spraying with Bordeaux mixture, and on the fruits by spraying with Bordeaux mixture or "Sulfinette" 1-2 per cent solution in water about once a week after the fruits have set until they are mature.

Leaf Disease.—The fungus *Pestalozzia Mangiferae* forms minute angular grey specks sometimes coalescing to form irregular dark patches on the upper surface of the leaves. The fungus is a weak parasite and does very little harm.

The above deals with the main pests and diseases commonly met with in cultivation, but it is important to remember that prevention is better than cure, and good sanitation and cultivation with the maintenance of a vigorous healthy tree in the best possible condition is one of the best safeguards, and the results of judicious applications of fertiliser at the proper time are important means of controlling insect growth as well as fungoid diseases.

Other enemies are undoubtedly squirrels and birds, and the picking of the fruit in a very unripe condition is usually the unsatisfactory means adopted to forestall these attacks. The depredations of flying foxes on ripening fruits have to be contended with and frequent firing at them with a gun scares away such depredators for a time and appears to be the most practical remedy.

9. GENERAL

Enarched and budded mangoes should normally fruit at four to six years from planting but there is great variation of fruiting age among different varieties. The tree normally reaches maturity at ten to twelve years of age and full crops can be

expected from thence onward for a period of a further twenty-five years or so after which the tree would begin to decline in yield.

Though grown and used chiefly for dessert purposes the mango has a variety of other uses also and in recent years small canning factories have been started in India for the purpose of preserving this fruit. There are varieties for this purpose and also for culinary purposes in respect to chutneys and pickling. The fruit when green is used in curries both in the fresh and in the dried stage or can be made into a curry which has a sub-acid taste, or thin honey-like cakes are made by squeezing the juice on plates or pans and allowing this to dry.

In regard to canning a small trade in this is being developed in India. Preliminary experiments in canning undertaken in the Ganeshkhind Botanic Gardens with a steam pressure canning apparatus capable of developing a pressure of 30 lb. per square inch, have proved that this can be successfully accomplished and it is believed that a taste for the fruit so treated can be created. As many as 18,000 cans of mangoes so treated is stated to have recently been shipped to England in a single year and on receipt were reported on as being well preserved and that the fruit retained their flavour quite as well as do peaches canned in California.

In the cultivation of mangoes in Ceylon the initial steps desired are the production of good, high quality fruits for dessert purposes. The question of grading, packing, etc., for shipment, or facilities for canning can well be left to a later date when the fruit is produced in considerably greater quantities. A local market exists for all that can be produced for many years hence and there is little doubt that boats calling at Colombo would also create a certain demand if regular supplies are forthcoming throughout the mango season.

For these purposes however marketing conditions need to be studied to some degree, and the Fruit Report of the Imperial Economic Committee published in 1926 covers the ground admirably. The report emphasises a feature applicable at this juncture, *i.e.*, that all countries which have succeeded in establishing a fruit trade have done so by means of (a) the planting of sufficient areas of a single variety; and (b) by the process of grading all such fruit.

The selection of the variety suited to the locality is important and some assistance can be afforded in this respect if the imported plants already in the locality can be studied. There are many such in the Jaffna, Anuradhapura, and Negombo districts and such are of course very suitable localities for the mango. It is not suggested that one district or locality should restrict itself entirely to any one variety of the fruit, but where a variety is selected it should be one of the best for that locality and that if more than one variety is grown each should be in an area sufficiently large to supply a good market demand.

The question of grading for market purposes is an intricate one but if the grower limits his selection to one variety he reaps a considerable advantage over the grower of several varieties since in the latter case no two successive pickings would be uniform. Where the grower operates on a large scale it is possible for him to market his own fruit, but for the smaller grower a trade organisation is called for with agencies at various centres to purchase the fruit from the grower and, by recognised and uniform methods of grading and packing, create a regular market and stimulate demand for this luscious fruit. Considering that nearly Rs. 800,000 worth of fresh fruit is imported into the Island annually, it is evident that home production of high-class mangoes on a sufficiently large scale can materially assist in reducing these figures.

A PRELIMINARY REPORT ON THE TRADE IN AND CULTIVATION OF SPICE CROPS IN CEYLON*

THE spices which enter into the Ceylon trade are as follows:

Cinnamon, arecanut, cardamom, pepper (*Piper nigrum*), nutmeg, cloves, mace, vanilla, chillis (red peppers), ginger and turmeric.

Of these the last three form imports mainly from India.

The position as regards the trade and cultivation of these spices is summarized in the following table and statement, and details regarding the trade are furnished in the subsequent paragraphs:

1. (A) TRADE

Crop	Value of produce (average of last 3 years)	Proportionate distribution of trade in 1929		Remarks
		U.K. and British Possessions	Foreign Countries	
	Rs.	%	%	
Exports				
Cinnamon	4,521,745	14	86	widely distributed
Arecanut	2,982,517	98	2	to India
Cardamom	762,599	30	70	distributed
Pepper	297,066	51	49	distributed
Nutmeg	35,240	74	26	mainly British India
Vanilla	13,986	100	—	chiefly United Kingdom
Cloves	13,127	99	1	mainly British India
Mace	2,017	100	—	British India
Imports				
Chillis	3,666,552	100	—	imported from British India
Turmeric	167,666	100	—	
Ginger	70,576	100	—	

(B) CULTIVATION

Cinnamon.—Regular pure plantations occur in the low-country in the Southern and Western Provinces and occupy about 25,800 acres. The cultivation is entirely in the hands of Ceylonese owners, and the majority of plantations are small varying from 20-50 acres. But there are many estates of 100 acres and in a few cases 200 acres and over. The crop comes usually in May-August and also in October-December.

Arecanut.—The estimated area is 68,800 acres distributed to varying extents in all districts but 47 per cent. of the total area is confined to the Sabaragamuwa Province. The chief district in which arecanuts are grown is Kegalle, over approximately 23,000 acres. This is not generally cultivated as a pure crop. More often trees are scattered indiscriminately over plantations, and a few trees may be found in every village garden.

Crops are obtained practically throughout the year, but more usually in August and in December.

Cardamom.—This crop is cultivated as a pure one mainly in the Central Province at mid elevation, 1500-3000 feet. The estimated area is 5,700 acres and plantations are chiefly on company-owned estates. The average

* Copy of report submitted to the Empire Marketing Board.

size of individual plantations varies from 50-100 acres, but three are many of 200-300 acres in extent. To a small extent plantations of 1-5 acres are owned by peasants, and small owners possess blocks of 20-30 acres.

The crop is gathered all the year round, but chiefly in February to March, and August to September.

Pepper.—This is not cultivated as a pure crop, and is found widely distributed in other plantations. While estates may have a few cases of pepper as a mixed crop, one or more vines may generally be found in peasant gardens.

Based on the produce exported and an average yield, it is estimated that the area under pepper is about 250-300 acres.

Nutmegs, mace, cloves, vanilla.—There are no regular plantations of these crops. Small patches of vanilla may occur on a few estates, and individual vines in peasant gardens. Nutmeg and clove trees are scattered about chiefly in the Central Province and receive no regular cultivation.

Chillis.—This is freely grown throughout the Island, but the crop is used in the unripe state. Cultivation is carried on, on a larger and more systematic scale in the Northern Province, and all efforts are being made to popularize cultivation on a commercial scale in other parts of the Island. The imports constitute dried chillis which are used as a comestible though differently from the unripe product.

Turmeric.—This is not cultivated in the Island.

Ginger.—This is not systematically cultivated except to a very limited degree in the Central Province, and it is used in the fresh state. The imported product is received in the cured or dried condition.

2. The following table shows the position of the spice trade during the three quarters of the present year compared with that of corresponding periods for last year:

Crop		First Quarter	Second Quarter	Third Quarter	Total for 3 Quarters
Exports		Cwt.	Cwt.	Cwt.	Cwt.
Cinnamon	1929	9,942	10,639	13,900	34,481
	1930	10,020	8,860	13,246	32,126
Arecanut	1929	36,695	24,747	44,337	105,739
	1930	28,648	16,903	30,719	76,270
Cardamom	1929	848	728	404	1,980
	1930	785	936	502	2,223
Pepper	1929	1,934	1,040	2,203	5,177
	1930	1,365	430	483	2,278
Nutmeg	1929	233	254	272	759
	1930	53	125	256	434
Cloves	1929	336	194	8	538
	1930	27	46	11	84
Mace	1929	3	20	6	29
	1930	—	4	6	10
Vanilla	1929	—	—	—	—
	1930	3	—	8	11
Imports					
Chillis	1929	41,376	33,550	25,527	100,813
	1930	46,031	36,647	34,751	117,429
Ginger	1929	804	604	676	2,084
	1930	927	568	836	2,331
Turmeric	1929	3,579	3,216	2,969	9,764
	1930	2,883	3,217	2,657	8,757

3. DISTRIBUTION OF EXPORTS

Cinnamon.—The trade is very widely distributed, and markets are found in no less than 24 countries, of which 9 are in Europe and 9 in North and South America, 8 are British and 16 foreign countries.

The largest buyers in 1929 were Mexico (9,300 cwt.), Spain (7,644 cwt.) U.S.A. (6,823 cwt.), Germany (5,853 cwt.), and United Kingdom (4,296 cwt.).

An appreciable expansion of the trade with the South American countries as well as with Germany and Holland has been taking place. Trade with U.S.A. is falling badly. Exports have been steadily increasing during the past three years.

Arecanut.—The trade is practically entirely with India and has been gradually improving during the past three years.

A small quantity is exported to Europe, but the trade is a very unsteady one.

Cardamom.—Trade improved in 1928 but dropped back in the next year. European markets absorb 65% of the exports, the chief buyers being the United Kingdom, Germany, Sweden, Denmark, and Norway. The trade with the United Kingdom, however, is steadily declining (1927—1,059 cwt.; 1928—1,036 cwt.; 1929—689 cwt.) while that with Japan has shown an improvement.

Pepper.—Trade dropped in 1928 to 2,916 cwt. but recovered remarkably in 1929 and reached 5,078 cwt. Markets are widely distributed, the chief buyers being British India 30%, United Kingdom 14%, U.S.A. 18%, and Mexico 12% of the total exports in 1929.

Trade with British India and Mauritius is expanding steadily, while that with the United Kingdom recovered well after a drop in 1928.

Nutmeg and mace.—Trade is entirely with British India and a slow advance is noted.

Cloves.—British India is the only market and a phenomenal rise in exports occurred in 1929, viz., 517 cwt., over 84 cwt. in 1927 and 67 cwt. in 1928.

Vanilla.—Exports have fluctuated greatly during the past three years—viz; 1927—24 cwt.; 1928—32 cwt.; 1929—6 cwt.

Trade is chiefly with the United Kingdom. U.S.A. took the bulk of the exports in 1928, but dropped out the next year.

Chillis.—Imports rose in 1928 but dropped in 1929 to below those of 1927. The rise in 1929 was helped by 2,263 cwt. from the Straits Settlements and 1,478 cwt. from Java. The bulk of the trade is with British India.

Turmeric.—Imports are steadily rising and the trade lies with British India.

Ginger.—The imports rose in 1928 but showed a slight decline the next year.

The bulk is obtained from British India, but last year small quantities arrived from Hongkong and the Straits Settlements.

4. Statements of exports and imports of spice for the past three years.

	1927	1928	1929
Exports	cwt.	cwt.	cwt.
Cinnamon	42,415	45,722	48,217
Arecanut	118,278	123,338	144,169
Cardamom	3,177	3,337	2,849
Pepper	3,880	2,916	5,078
Nutmeg	351	538	928
Cloves	84	67	517
Mace	27	31	33
Vanilla	24	32	6
Imports			
Chillis	146,488	151,124	140,111
Turmeric	10,635	11,099	12,995
Ginger	2,262	3,078	2,928

LATEX TUBE BORE THEORY

MR. ASHPLANT'S REPLY TO HIS CRITICS*

IN the South Indian *Planters' Chronicle* of 22nd November, Mr. H. Ashplant makes a reply to the critics of his Latex Tube Bore Theory. It should be explained that repeated attacks of fever compelled Mr. Ashplant to abandon his scientific work in South India in the autumn of 1928 and come to Europe for medical treatment. He returned in June of the following year with the intention of resuming his investigations into latex tube bore and publishing a full report on the subject. On the way out, however, he had the ill-luck to contract a serious throat trouble which entailed complete loss of voice for months and which failed altogether to yield to local treatment. This and the recurrence of his old fever necessitated his return to England in February of this year where he has been undergoing an operation. It is to be feared that medical reasons preclude Mr. Ashplant from again residing in the Tropics.

His prolonged illness has prevented him keeping in touch with recent literature on rubber, but from such extracts as he has seen he is of opinion that it would be misleading to regard Dr. A. Frey-Wyssling's paper (of which an account was given in *The Tropical Agriculturist* for March 1931) as an attack on the theory.

The tube bore theory, he contends, is merely going through the healthy process of criticism and investigation by other scientists, which is the lot of every new idea to science. It will be modified, as all new theories are bound to be, by later workers, but that latex tube bore as an important factor in latex yield will ever be displaced, or the main props of the theory overthrown, is to him and, he adds, to those who have seen something of the enormous body of evidence accumulated at the rubber Experimental Station, simply inconceivable.

Rightly understood, he claims, the investigations of Frey-Wyssling, far from attacking the tube bore theory, actually support it. "This, the first research into the problem since my own work, confirms the new factor as the most important determinant of rubber yield and at the same time it substantiates the two main claims I have endeavoured to establish:

"In the Report of the Experimental Station, 1928-9, I claimed to have made two observations: (a) That trees with latex tubes of below a certain average bore are almost invariably poor yielders; and (b) that good yielding trees just as invariably possess latex tubes of above this average bore; and I went on to say: 'Experience shows that from 55 to 65 per cent. of the trees on the average estates or in the average nursery belong to class (a). The recognition in the nursery stage and the removal before planting of this class will enormously increase productivity.'

"With regard to the higher class of trees with tube bore above the minimum size, while there is a relation and a very marked relation between the tube bore and yield, the position of any tree in the class cannot be precisely indicated without a pre-knowledge also of the number of rings the tree will develop. No signs are known whereby the ring-forming potentialities of a tree can be determined in its infancy and until we have more knowledge of this factor it will be impossible to say whether a nursery

* From *The India Rubber Journal*, Vol. LXXX, No. 25, December, 1930.

plant will grow into a six, eight or ten-pounder tree. The close correlation between tube and yield might enable us to place a tree as good or very good in the (b) class with a high degree of probability, but all that I am concerned to claim here for tube bore measurements, is that they enable us to discriminate between the potentially poor and the potentially good. This is a big advance!

"Now, as to the claims made, Frey-Wyssling's paper also shows and admits that trees with narrow bore latex tubes are always low yielders.

"The second claim that good-yielding trees possess latex tubes of above average bore is confirmed by such of Frey-Wyssling's measurements as I have seen and it should be noted that the tube bores of all the AVROS' buddings examined were found to lie between 16 and 18 microns, all ranked, in fact, as 'A's' or 'B's,' the two classes in which for practical purposes we have been accustomed to group good-yielding trees in South India, it having been observed that good yield was always associated with trees with tube bore of from 15 to 20 microns. The chief difficulty was with trees possessing a tube bore lying between 13·8 and 15 microns any one of which might develop into passable yielders, given a high number of latex rings. An average tube bore of less than 13·5 microns seems to be incompatible with good yield, excepting very rare cases where the number of latex rings is phenomenal.

"So far as the main principles go, then the Dutch investigator's researches are a vindication of the tube bore theory, where he diverges from me is in the degree of correlation observed, and hence in the utilisability of the theory.

"The number of trees examined by Frey-Wyssling was absurdly few and I have no doubt that the difference between the correlation coefficient found by him of 0·54 and that by me of ·075 is partly due to this. It is also partly explained by the selected nature of Frey-Wyssling's material. He concluded in his tables no tree with tube bore of less than 14 microns, which will seem an unfair assortment when it is pointed out that 128 of the trees figuring in my tables or 50 per cent. have tube bores of from 13·5 down to 10·5 microns.

"I am indebted to Mr. G. N. Frattini, who has kindly re-examined the tables, for pointing out that if in my correlation material all individuals of less than 14 microns diameter are omitted, a correlation of 0·537 is obtained.

"I will not emphasise the clones agreement of this figure with that of Frey-Wyssling. There will be time enough to discuss correlation values when Frey-Wyssling or some other investigator tackles tube bore measurement on a comparable scale.

"With regard to the choice between budding and tube bore selection, this depends upon local circumstances. There is no question but that propagation from the few *elite* trees which have been proved to transmit their desirable qualities of high yield and vigorous growth must be preferable to selection from the common herd, whether the selection is by tube bore or any other test. All that any test applied to the ordinary population can do is to weed out the unfit. For the real aristocrat among rubber trees may occur but once in ten thousand. The discovery of a mere dozen *elite* trees has taken the Dutch East Indies over 12 years, and even in regard to some of these much uncertainty prevailed up to a year ago. Outside the Dutch East Indies no really proven bud mothers of local origin were available, and in the prevailing uncertainty a method of eliminating the duds, such as that worked out by me, was more dependable than budding adventures with unknown and frequently brown bast tainted stock. It was infinitely preferable to the indiscriminate planting still going on when I introduced my method, and when the real test of actual tapping can be undertaken, 'later-day Buddists' will have no cause for dissatisfaction with the tube bore selected areas.

"IF BUDDING HAD COMMENCED FIVE YEARS EARLIER"

Referring to budding and the present situation in the rubber industry, Mr. Ashplant says: "If the scientific critics of my theory who are, in the rebound, showing such enthusiasm for budding had, years ago when budding was unpopular, displayed a little more courage and foresight, the rubber industry might not have reached its present 'impasse.' Up to four years ago I was the only scientific man in British planting circles who foresaw the possibilities of budding and pressed its adoption on the planting community, and it should not be forgotten that it was the bright idea of pruning bud mothers, originated by me, that made budding practicable in South India and Burma, not to mention some parts of Ceylon.

"Though sighs for lost opportunities will not now recall them, one cannot help wishing that interest in and research into methods of increased production had commenced five or ten years earlier, instead of with the first serious price decline. Had large highly-selected plantations, capable of yielding 700 to 800 lb. per acre, been in existence by, say, the year 1919 it is safe to say that much of the vast native area with its uncontrolled riot of production, would never have been planted. Any fool can plant rubber and to the far-seeing it has always been evident that a thing that offers an easy profit to anyone would eventually, be overdone unless more efficient methods demanding greater intelligence were introduced. The tragedy is that we have waited until the planting of rubber was overdone, almost before we generally awoke to the danger. By failing to apply science in the one direction in which European skill and resource could achieve definite superiority, *i.e.*, in securing higher productivity, we have temporarily lost the race.

"Nothing can now avert a brutal period of economy and readjustment, which is likely to be very prolonged unless rubber producers, like other business men, realise the folly of producing at a loss and rest their plant until demand revives.

"We have suffered too much from optimists in the rubber industry, particularly from the prognosticator of 'booms.' If continued production is a form of optimism, the sooner we have a little pessimism the better.

"The rubber-planting industry has one unique feature which may be a matter for self-congratulation or otherwise according to whether we think of ourselves or our competitors, but is in any way of benefit to the world at large. It has the immense advantage over other industries of a plant that improves when left idle. If there is another consoling reflection, it is the economic truth that no useful commodity can permanently remain below its cost of production."

RICE CULTIVATION IN ITALY*

IN accordance with instructions from the Colonial Office, I was privileged to visit the Rice Experimental Station at Vercelli (Italy) in order to study the latest methods employed there for the improvement of rice cultivation generally.

The Rice Experimental Station was founded in 1908 and is financed chiefly by contributions from the cities of the province (IL Vercellose), the Chamber of Commerce, the Farmers' Syndicate and by Government.

The definitions and explanations of measures, etc., given in this article are as follows:

(1) Hectares—2·47 acres.
(2) Quintal—100 Kilos—220 lb.
(3) Kilo—2·2 lb.
(4) Paddy—Grain before being husked.
(5) Exchange—93·25 lire to £1.

The Institution is separate from the Agricultural Department and is devoted entirely to the improvement of rice and experimentation with fish (*carp*). The work is divided into the following sections:

(1) Agriculture
(2) Machinery
(3) Chemistry
(4) Genetics
(5) Fish

There are also thirty hectares (74·1 acres) of paddy land under the control of the Institute for experimental work. The following is a brief *résumé* of the class of work done under each of the above sections:

1. Research work with new varieties, both in the field and at the experimental station. The selection of seed in mass on the farms, manurial trials and the general study of new methods of rice cultivation.
2. The study of rice agricultural machinery. At the present moment the improvement of the machine for transplanting rice is being worked upon. The officer-in-charge of this branch is a fully qualified engineer.
3. Research work connected with rice, manures, and soils.
4. Hybridization and pure-line selections.
5. Experimentation with carp and propaganda work.

The area under rice cultivation in Italy at the present time is approximately 150,000 hectares (370,500 acres) and I was informed that this area will not, to any extent, be increased in the near future, chiefly because of the system of agriculture practised and also that all suitable irrigable land is already under rice cultivation.

It is estimated that 90-95 per cent. of this area is situated in the North of Italy.

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* By F. Burnett, M.C., M.A. (Oxon.), Deputy Director of Agriculture in *The Agricultural Journal of British Guiana*, Vol. III, No. 3, September, 1930.

The farms can be divided into two distinct classes, (1) large farms of between 200 to 300 hectares (494-741 acres), and (2) small farms of 10-15 hectares (24·7-37·05 acres) each. An interesting point about these is that the small farms are generally owned, whilst the large farms are generally rented. The rent for paddy land is paid in kind, varying from 10 to 15 quintals (2,200-3,300 lb.) according to the richness of the land per hectare. All the paddy is grown on irrigable land and there is an ample supply of water.

There are very few varieties grown, compared with other rice-producing countries—estimated to be less than twenty, of which the following are the chief :

1. Americano 1600 (awnless).
2. Ostiglia (awned)
3. Bertone (awnless)
4. Lencino (awned)
5. Ranghino (awned)
6. Nero Vialone (awnless)
7. Orijinarios (awnless)†
8. Onsen†
9. Sekyama (awned)
10. Sancius (awnless)
11. Precoce (awnless)
12. Precoce Declarole (awnless)
13. Precoce Allorio (awnless)
14. Precoce Giallo (awnless)
15. Precoce Vittoria (awnless)
16. Maratelli.

The chief kind grown is the original Chinese variety (*Originario cinese*) and it is estimated that four-fifths of the whole area is under this variety. The varieties above marked † sign are also heavy yielders. The age of each, from the time of sowing to maturity, varies from 5 to 5½ months. Only one crop of paddy per year is grown. The yield per hectare for the 1930 crop was estimated, on an average, at 55 to 60 quintals (5-6 tons) equivalent to 100 to 120 bushels per acre.

Every year the Institute imports new varieties from other rice-growing countries, but from Japan and America chiefly. These varieties are sown on the Experimental Station, and if they show signs of conforming to requirements, *i.e.*, heavy yielders, even samples for commercial use, freedom from disease, they are then given out to various large farmers for trial and acclimatization. Some farmers have as many as 15 to 20 varieties in small lots. I was privileged to visit several of these farms, and the variation in growth and the age of ripening was, as usual, very great. The best varieties are, however, eventually harvested and seed kept for further trial. It takes two or three years before a new variety becomes acclimatised. Varieties even vary in time to maturity when exchanged between the North and South of Italy. Where a variety has been found suitable, the area is gradually increased each year. This was the method employed with the variety Americano 1600. The seed was only imported in 1920, and it is estimated that four-fifths of the whole area under rice cultivation is now grown with this variety. Seed in large quantities is not distributed from the experimental station.

There is no dry rice cultivation.

The typical rotation in the region most intensively cultivated with rice (IL Vercellose) is the following :

1st year—Wheat.
2nd ,, —Meadow land.
3rd ,, —Meadow land with casual maize and transplanted rice.
4th ,, —Rice.
5th ,, — ,,
6th ,, — ,,
7th ,, — ,,

General cultivation commences in April. The only difference in the general methods of cultivation of rice following wheat and rice following rice is that transplanting is necessary after wheat, instead of broadcasting, to ensure its ripening at the correct time. Every precaution is taken to ensure that the crops are ready for reaping in September, as the harvesting season is short and different from other rice-growing countries where this season is much longer.

Before ploughing the land, farmyard manure is applied in varying quantities according to the amount available up to 400 quintals (approx. 40 tons) per hectare. The land is then ploughed and on some farms, where the tractor is used, the harrow is also attached to the plough, and both operations carried out at the same time.

Tractors are only used on the large farms. On the smaller farms ploughing is done by means of horses and oxen.

Where farmyard manure has not been applied, artificial manure is applied at the time of sowing at the following rate per hectare :

8 quintals (1,760 lb.) of superphosphate.
3 ,, (600 lb.) of potassic manure and if the crop requires it.
1 quintal (220 lb.) of sulphate of ammonia after weeding.

One farmer informed me that he used sulphate of ammonia only, at the rate of 250 kilogrammes (550 lb.) per hectare.

The soil is then harrowed a second time and irrigation commences. After 4-5 days the soil is well mixed by means of a puddling machine drawn by a tractor or horses. Levelling is, however, done entirely by hand implements.

Before sowing commences, either in the nursery or in the field, the seed is selected by a machine. This machine is in use on large farms, is popular and effective. On small farms sowing by hand is still in practice.

It is estimated that 25 per cent. of the total rice area is transplanted. A machine for transplanting is in use, but it is not yet very popular. This undoubtedly is due to the failure of various types of transplanting machines that have been previously placed on the market. The latest machine is claimed by the Institution to be fairly successful. Last season it was estimated that, out of 35,000 hectares (86,450 acres) transplanted, about 5,000 were planted by the above type of machine. The work of transplanting with this machine has to be done slowly, and with very little water in the fields. Horses dragging the machine have to be changed every two hours. It is estimated that one hectare can be transplanted in one day. The plants, whether by machine or by hand, are planted in threes and fives at 8 inches apart. If transplanting is done by hand, it is estimated that it will take 40-45 women one day of 8 hours to transplant one hectare.

The sowing of the seed on the remainder of the area—115,000 hectares (284,050 acres)—is done by machines on the large farms and broadcast on the small farms. This type of sowing machine has been evolved after considerable experimentation, is efficient, and very popular.

The rate of sowing is 150 kilogrammes (330 lb.) per hectare. Thinning-out is done both by machine and hand. Where the seed has been sown by a "drill" or transplanted by a machine, then weeding with a horse-drawn machine is possible. This type of machine is considered most satisfactory. When the crop has been broadcast, then weeding is done by hand.

The harvesting is done entirely by hand by means of a sickle. The water is drawn off the fields about 14-21 days before harvesting commences and clover sown (*Trifolium incarnatum*). Reaping machines are not in use, and attempts made so far have ended in failure. Several types have been tried, both horse and hand motor reaping machines, but they have not been successful.

The crop is then carted to the homestead and threshed by means of a threshing machine. On large farms the machine is fixed. The small farmer gets his threshed by means of an itinerating threshing machine, *i.e.*, on the same principle as the English small farmer gets his corn threshed.

It is estimated that about 16 quintals (3,520 lb.) can be threshed in one hour. The grain is then winnowed and dried.

The winnowing machine is called a *pulitore*, and the drying machine an *essiccatoio*. Due to uncertain weather for drying the grain, artificial drying is resorted to, although on the small farms it is sun-dried by being placed in the sun on cement and asphalt floors. Unless the paddy is to be husked and polished, it is now ready for sale. Both the large and the small farmers dispose of their crop as paddy, which is generally purchased by the rice millers who prepare it according to the demands of the different markets. The rice in some cases is not polished, owing to a lower export rate for unpolished rice, and it depends on the market price whether or not it is profitable to polish.

Both the paddy in the rough and cleaned rice are sold to private stores. The charge for husking and polishing 100 kilos (220 lb.) is 7 lire ($0·36) plus the by-products after husking.

The proportion of rice to paddy is 63-65 per cent. and the remainder is made up of 20 per cent. husks, 9 per cent. broken rice and 6 per cent. meal. The husks are used as firing material, the broken rice is generally converted into beer and there is also a market for the meal. These private stores are established in every large rice-producing district in the North of Italy and are entirely privately owned. In Vercelli town there were seven such factories of commerce.

I was informed that there were no co-operative buying or selling institutions in operation as far as rice is concerned.

The crop everywhere is fed entirely throughout by means of irrigation and does not depend on rain water. There is a water rate levied, amounting to between 250 and 300 lires ($12·87-$15·44) per hectare per annum. The consumption of water varies in the following manner:

Clay soils	1·5 litres (0·33 gallons) per hectare daily
Intermediate soils	2·5 litres (0·55 gallons) per hectare daily
Light soils	5·0 litres (1·10 gallons) per hectare daily

There is no malaria in the rice-growing districts now, although I was informed that the mosquito is still found. The eradication of fever is thought to be due to better sanitary conditions and also to the growing of crops in rotation in irrigated fields.

It is estimated that 25-30 per cent. of the crop is exported yearly, the chief countries outside Europe being the Argentine and Chile. Rice is eaten in Italy, mixed with vegetables in soup, curried with meat and ground into flour.

In my opinion the flavour of the rice is not as good as that of some of the varieties grown in Ceylon, nevertheless it should be maintained that Italian rices are regarded with favour on the international market.

The price of manual labour varies from 15 to 20 lire ($0·77 to $1·02) per day according to the grade of workman and time of the year. During the harvesting period, 20 lire ($1·02) a day is paid. Women are paid a little less, but, during harvest, 18 lire ($0·95) a day is paid.

As far as I could ascertain no assistance or support is given to the farmers from Government excepting through and by this Institution. Money, however, can be borrowed from agricultural banks at the rate of $6\frac{1}{2}$ per cent. on security of the crop after inspection.

There are no pests of importance. A recently imported variety of paddy had, however, met with misfortune and had completely died out. The crop had grown and eared well, but just before ripening it entirely failed. This is one of the difficulties of acclimatization, in spite of the success of this variety the previous year.

The study of economics of rice cultivation has not yet been attempted at the Institute. The labour question, however, is not, I understand, a difficult one, and during the busy times of the year the farmers co-operate and help each other.

In *IL Giornale de Risicoltura* for June 1929, full details are given of the methods of hybridization employed at the Institution. By this method 95 to 97 per cent. successes are obtained.

The names and addresses of firms supplying the rice machinery now used on the farms are as follows:

Agricultural Machinery	...	Cabbrini and Mocchi, Pavia
Husking and Polishing machine	...	Morandi and Minghetti, Vercelli, Italy.
		P. Cattananeo and Figli, Pavia, Italy.
Threshing machines	...	Brusa Vittore, Vercelli.
		Sacerdate, Coutoni & Co., Vercelli.

I was able to obtain a wide range of photographs dealing with rice cultivation in its various stages, but, as space will not permit publication, I shall be happy to loan them to anyone interested.

ROOTSTOCK INFLUENCE IN FRUIT GROWING*

THE fruit grower has always found one of his outstanding difficulties in the variability of his produce. The fact that varieties seldom, if ever, come true from seed, caused in the first instance propagation by seed to be abandoned in favour of a vegetative method which reproduces completely the characteristics of the parent plant. As, however, not all desirable varieties are capable of producing suckers or forming adventitious roots from the stem for layering, it has been found in practice preferable to bud or graft the variety with desirable fruiting qualities on to an independent root system. Thus the great majority of the tree—fruits, such as the apple, pear, plum cherry, peach, citrus fruits and, in some countries the vine, are produced by means of budding or grafting and hence are composite structures made up of two individuals the scion and the rootstock.

Variability is not, however, entirely eliminated by means of the composite tree. That the rootstock may influence the tree in certain ways has come to be recognized by nurserymen and growers, at any rate, in Western Europe. The rootstock may be a seedling or may be formed by layering some readily rooting variety. There has been a widespread idea that a seedling stock will give the vigour of growth necessary for an orchard tree, while a layered stock is shallow rooting and will produce a small and comparatively early cropping tree. Since the scion variety is in reality a single individual, any difference must be attributed to the influence of the stock, and the recognition of this fact caused studies of the two kinds of fruit tree stocks in common use in Western Europe to be undertaken in Engand in 1913.

The variability of the seedling stock was recognized by growers as being often reflected in the scion but was regarded as inevitable on account of its origin. It was a common experience for a grower who had stocked his orchard with a single variety in apparently uniform conditions to find the trees developing the most diverse habits of growth and cropping capabilities. To quote an actual case: some early Victoria apples, budded on seedling stocks, were selected from the nursery as one-year-olds for their uniformity in size. Twelve years later at Malling the trees range from spreading dwarfs to vigorous upright trees and their cropping is equally varied. The best trees in the group bore at the rate of 51 tons an acre and the worst at the rate of 10 tons. This means that the grower of a mixed lot of trees such as these would at the end of 13 years from planting have harvested about 28 tons of fruit per acre, whereas if he could have standardised his trees to produce at the rate of the best he would nearly have doubled his crop.

The standardisation of seedling stocks, in the first place for the apple, was undertaken by the Research Station at Long Ashton, Bristol. An attempt was made to obtain uniformity by finding typical vigorous seedlings suitable for the production of orchard trees which were also capable of being propagated by vegetative means. This object was achieved in the rootstock now known as Bristol V, which is layered but retains its deep rooting system and gives a large slow-cropping orchard tree.

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* From *International Review of Agriculture*, Year XXI, Part I, No. 5, 1930.

This orchard rootstock fulfils the growers' requirements of uniformity but from the economic point of view it has lost the seedling stock's advantage of easy and cheap production, and other methods of obtaining uniformity may be desirable. One method suggested is the grading of seedling stocks in the nursery. It is recognised that the nursery practice used in producing a standard tree necessitates a certain amount of selection to obtain the required height of stem, the weaker stocks being eliminated in the process, but this entails waste and again increases the cost of production.

The process of "bench grafting" which is much used in the middle west of the United States, seems to bring about a considerable degree of uniformity in the orchard. The scion is grafted directly on to a portion of the tap-root of a seedling stock and it is now thought that by this means the influence of the stock is eliminated. It has been shown that the root system of the resulting tree is so much influenced by the scion that varieties can be distinguished by their roots alone. This method would seem to be entirely satisfactory if uniformity in the orchard was all that was to be desired and if different climates, soils and purposes had not to be taken into consideration. It is obvious that if the individual characteristics of both the rootstock and the scion can be retained and their interaction understood, a far wider range of possibilities is opened up.

That the stock has a far wider influence than was at first realised has been discovered by the East Malling Research Station, which undertook the study of layered stocks in 1913. The work was begun with the object of identifying the different vegetatively propagated rootstocks in commercial use. The layered stock which at least should be uniform, was frequently misnamed and not true to type, and considerable confusion arose, because the nursery men did not know the possibilities of the young trees. Perhaps a variety sold to a grower as being on a "Paradise" or layered stock and therefore suitable for interplanting between his permanent standard trees, turned out to be as slow-growing and wide-spreading as the permanent trees; he had to wait eight or more years longer than he expected for any return on his outlay and in addition his orchard became overcrowded.

The analysis of these stocks at Malling soon showed that the so-called dwarfing stocks consisted of 17 varieties which could be divided into four groups showing striking differences in their influence on the tree.

The following table shows a comparison of the size of trees and the cropping capacity of Lane's Prince Albert worked on a representative of each of the 4 types and grown on good medium loam at East Malling:

Table I

Stock	Suitable number of trees per acre.	Crop returns per acre (bushels)	
		Total for first 4 years.	Total for first 7 years.
Dwarf IX ...	504	106	1,123
Semi-dwarf II ...	268	34	590
Vigorous I ...	150	4	302
Very Vigorous XVI	101	...	152

It is seen that the relative order of cropping in early years is the converse of that of vigour and from the space required that the trees on stocks I and XVI develop into fully-sized orchard trees. The results of

this work are that (1) the grower can now plant one variety, if he so desires, as permanent trees and fillers, because he knows the relative vigour of the rootstocks, (2) he can be certain of early return from the dwarf trees, (3) he knows how to space the trees when planting so as to make full use of the ground when the larger trees have come into full bearing, and (4) he can make his provision for tillage operations knowing with considerable accuracy the type and size of machinery which will be suitable. Such a measure of control more than compensates for the extra cost of a layered stock.

Similar trials on different soils with the same variety on the four types of stocks have shown that the rootstock must be selected in relation to soil conditions as well as to the purpose of the tree. It was found that the absolute size of the tree on any given stock differed markedly on different soils, yet in each case the relative vigour and precocity remained the same. Table II shows the behaviour of two very different varieties on the four stocks on different soils.

Table II

Soil type	Dwarf	Semi-dwarf	Vigorous	Very Vigorous
			Bush Lanes	
Medium Loam	Moderate	Good	Vigorous	Very vigorous
Sandy Loam	Small	Moderate	Vigorous	Vigorous
Heavy Clay	...	Moderate to poor	Good	Vigorous
Light sand	Very poor	Poor	Small Bramleys	Moderate
Medium Loam	Good moderate bush	Vigorous	Very vigorous	Too vigorous
Sandy Loam	...	Good	...	...
Heavy Clay	Very small	Good, Small	Good	Vigorous

It is hoped in time to be able to construct similar tables for all possible combinations of soil and variety.

Another characteristic which appears to be influenced by the rootstock is the time of blossoming. Control of this feature is of value from two points of view: in places liable to late frosts it is advantageous to be able to grow trees on vigorous stocks which cause late blossoming, and in view of the present knowledge of self-sterile and inter-sterile varieties it is obviously useful to be able to ensure that two varieties which are planted together for pollination purposes will be in blossom at the same time.

Fruit quality as expressed in colour and size is another character which is most certainly influenced by rootstock. It has been found that the very dwarfing stock, Malling Type IX, produces pre-eminently fine quality dessert apples which are larger and appear riper than fruit of the same variety picked from other stocks, and are equally good for storing. On the whole the more vigorous stocks tend to give less colour, the apples appearing green when ripe on vigorous Type XVI, and the fruit tends to be smaller on vigorous stocks, though size is apt to fluctuate from year to year on the same tree. It is evident that in the nursery certain apple stocks are far more susceptible to certain diseases and pests, such as canker (*Nectria galligena*) scab (*Venturia inaequalis*), mildew (*Podospharea leucotricha*), crown gall (*Bacterium tumefaciens*) and leaf scorch than others, and facts are gradually accumulating from orchard experience and direct experiments which show that the varying susceptibility is transmitted to the scion.

Investigations into the nature and effect of pear, plum, peach and cherry stocks have also been carried out at Malling. In each case the commercial stocks were found to lack uniformity, and the first work was directed towards bringing order out of chaos.

In the case of pears it has been found that certain of the quince stocks in common use show a marked "incompatibility" with certain varieties, which explains many previously unaccountable failures in the orchard. Some quince stocks have been found to induce earlier fruiting than others. It has been possible also to select and propagate vegetatively a series of a pear rootstocks which will give a wide range of performance when grafted with a given variety. There are indications of disease resistant pear stocks and in America pears on certain rootstocks have been found definitely more susceptible to a physiological disease known as "black-end" than others, some often showing 100 per cent. immunity and others 100 per cent. susceptibility.

In the work with plum stocks for plums and peaches striking evidence has also been obtained of "incompatibilities" and of stock preference with several of the common commercial varieties. And although at present it is not as easy as in the case of apples to control the size of the plum or peach tree by the influence of the stock during its development, it has been found possible to vary its period of blossoming and habit of growth by this means.

Thus the variability which was one of the chief obstacles to successful fruit growing has been brought under control and turned to account. It is possible for a grower to-day to predict with considerable exactitude over a wide range of conditions of soil, variety, etc., the approximate size to which an apple tree will grow, the age at which it will come into cropping, and even other factors such as its period of blossoming and its propensities to certain diseases and pests, and the size and quality of the fruit itself. There is also already sufficient evidence obtained from work on the stone fruits and citrus fruits to show that the day is probably not far distant when it will be possible similarly to control by means of the rootstocks all fruits grown as composite structures.

THE STORY OF TWO DECADES OF CHEMICAL RESEARCH ON PADDY SOILS IN THE MADRAS PRESIDENCY*

PADDY or rice (*Oryza sativa*), being one of the principal food crops of Southern India occupying the largest portion of the cultivated area was the first to receive the attention of the Department of Agriculture since the commencement of agricultural research in this Presidency.

This article deals in popular language, with the investigations bearing on the study of the soil, the crop, the inter-relations that exist between soil conditions and crop growth, the mode of action of manures and the influence of manuring on the crop.

The practice of agriculture in its early days was based almost entirely on the results of accumulated experience. The cultivator had but little idea of the changes taking place in the soil or of the process controlling the fertility of the land. In consequence he was often unable to circumvent adverse influences. In course of time however, it was recognised that the factors involved in crop production were many and varied and the aid of science was invoked with the result that modern agriculture is a fabric built on a scientific foundation based on the labours of an army of investigators in a number of sciences all working in close collaboration with the practical farmer.

It is obvious that plants require food material for their growth and that as they thrive only in the soil, the food must come mainly from that source. The most important of these food constituents, from the point of their absorption by the plant in large quantities, are nitrogen, phosphoric acid, and potash. Investigation has shown that all the plant food present in the soil is not in a form capable of being utilized by the growing crop. Plants can take in their food only when it is dissolved in water and that portion of the plant food in the soil which is not soluble in water is of little immediate benefit to the crop. It is therefore customary to speak of the 'total' and 'available' plant food in the soil, the latter being that portion which is soluble in soil water and which can be at once taken up by the crop. It is thus clear that the 'available' plant food in a soil is the factor of chief interest to the cultivator as, other conditions being satisfactory, its amount will, within certain limits, determine the yield of crops. The total plant food is not without interest to the ryot. It is in fact an item of reserve deposit from which small quantities are drawn from time to time. There is, in other words, a slow conversion of insoluble material into soluble plant food for the gradual use of the crop and it is this change which enables soils to go on producing crops for very long periods even though no plant food is added in the form of manure. But if land is continually cropped, there must be a constant drain on the food supply present in the soil till it reaches a stage of minimum availability.

The yield from an acre of normal paddy crop (3,000 lb. grain and 3,000 lb. of straw) has been found to contain 48 lb. of nitrogen, 23 lb. of phosphoric acid and 41 lb. of potash and these constituents must have

* By B. Viswanath in *The Journal of the Mysore Agricultural and Experimental Union*, Vol. XI, No. 3.

come from the soil. If we visualize the soil as a bank, it is obvious that, unless what is withdrawn is returned, the account will soon be overdrawn. But wise Nature has foreseen man's greed and in her infinite wisdom has provided against his sins of commission and omission by setting up in the soil a mechanism for the indefinite supply of the bare minimum requirements, for what is ordinarily termed the minimum crop production. So that, if the few pounds of the manurial constituents taken off from the soil are not returned, there will not be a complete cessation of crop growth, but there will result crops poor in quality and quantity which means an inferior and insufficient food which in consequence produces a devitalized population falling an easy prey to all sorts of diseases.

It is a matter of great practical importance to ascertain to what extent the loss of plant food has proceeded, what reserves are available, and whether the soil is producing the maximum crop which it is capable of producing under proper management. To this end soils surveys of the more important paddy tracts throughout the Presidency were carried out. Many hundreds of samples, typical of the soils of each tract, have been collected and analysed. These surveys have yielded very striking results and show in a very marked manner how very deficient our soils are in certain ways and the large areas which demand immediate manurial treatment. The following tabular statement explains the nature and extent of the deficiency :

No.	Name of tract	Percentage of the soil deficient in	
		Nitrogen	Phosphate
1	Godavari ...	40	23
2	Kistna ...	33	55
3	Guntur ...	80	33
4	Tanjore ...	87	80
5	Periyar ...	0	90
6	Malabar ...	0	90

The surveys have, therefore, indicated, in a very definite manner the enormous loss in crop production which is taking place throughout the Presidency owing to the exhausted condition into which the soils have been allowed to fall, either through the ryot failing to appreciate the importance of manures or more usually through his inability to afford the cost of manures. Loss in yield, however, is not the only injury which results from the widespread deficiency of phosphoric acid. The results of experiments at Coimbatore have shown very clearly that in cases where phosphoric acid was deficient, not only was the yield reduced, but the composition of the crop was affected. Both grain and straw contained much less phosphoric acid than the crop from properly manured plots and hence the food value of the crop was much diminished.

The practical utility of the investigations mentioned above is obvious. With the aid of these soil analyses it has been found possible to ascertain the manurial needs of the areas and that of the paddy crop with the result that the nature of action of manures began to be investigated. The results of a large number of experiments in the field and in the pot culture house spread over a number of years have shown that all the natural and artificial nitrogenous manures are more or less beneficial to paddy but that they are more economical when applied in conjunction with bulky organic manures. Of the latter class of manures, green manures are pre-eminently suited to paddy crop. The results of the manurial experiments may be briefly described in numerical values comparing the relative merits of the different

systems of manuring with that of green manure, taking the value of green manure as the unit of standard.

No.	Manure applied		Relative efficiency
1	No Manure	...	0·33
2	Phosphate alone	...	0·50
3	Nitrogen alone	...	0·70
4	Nitrogen *plus* Phosphate	...	0·90
5	Green Manure	...	1·00
6	Green Manure *plus* Phosphate	...	1·20
7	Green Manure *plus* Nitrogen	...	1·33
8	Green Manure *plus* Phosphate *plus* Nitrigen	...	1·60

Potash is not included in the investigations as our soils are generally well supplied with this constituent.

The numerical values mentioned above refer to the results of pot cultures. The results of field trials are of a simpler order.

These experiments show that of the three most important manurial constituents, namely, nitrogen, phosphoric acid, and potash, the last-named does not appear to be necessary except perhaps in rare cases or where it is indicated to counteract disease. Nitrogenous and phosphatic manures are in general need and are responded to by the crop when applied singly or together, but their effect when combined is better. Phosphatic manures have been found to stimulate the assimilation of nitrogen which would otherwise not be utilized and also to enrich the composition of the crop in this constituent thus enhancing the nutritive and seed value of the grain.

It is seen that artificial manures are not as efficient as green manures for paddy and that the efficiency of either class of manures can be considerably improved by combining them. This raises the question as to the proportion in which artificials and green manures should be used. In so far as the Coimbatore soils are concerned, it would appear that a mixture of two-fifths of artificial nitrogen and three-fifths of organic nitrogen make a suitable combination for paddy. Larger dressings of green manure appear to render supplements of artificial nitrogen like sulphate of ammonia ineffective.

The study of the soil conditions and the nutrition of the paddy plant with special reference to the practice of green manuring marks a distinct advance in our knowledge of the nature of action of green manure under puddled and swampy conditions.

Paddy in this Presidency is generally grown under swampy conditions and in a puddled soil throughout the growing season, and yet no general system of cultivation holds good for all tracts, so that it cannot be said that the system adopted in one locality holds good in another. In South Malabar, the general practice is to plough the lands in the dry season with excellent results, but this practice introduced into the deltaic tracts resulted in failure. Green manuring is found beneficial in one area but when tried in another the crop fails. In some places water may be run on to fields and puddling and manuring done weeks before the crop is planted, but in other districts the custom is to put in the green manure just before transplanting. These and other mutually opposed facts make it essential that the conditions governing the growth of paddy should be closely studied in order to obtain, if possible, some common basis capable of explaining them before any improvements in paddy cultivation can be considered.

Since green manure undergoes putrefactive fermentation when buried under water, it was considered that an examination of the soil gases would make an opening to the problem. The first investigation showed that the normal fermentation of green manure in swamp paddy soils leads to the production of different gases and that the introduction of a crop into the field modifies the proportion in which some of the gases are produced and inhibits the production of others. The soil conditions are found to be anaerobic in character and therefore, nitrification is impossible and the nitrates produced during the period when the soil was dry are quickly denitrified. Under these conditions, therefore, the nitrogen required by the crop is obtained in the form of ammonia and probably from other nitrogenous organic compounds produced by the anaerobic decomposition of the proteins in the green manure.

Certain substances formed as a result of this decomposition are toxic to the crop and should be removed in the drainage water or should be destroyed by prolonged decomposition before seedlings are transplanted.

A more detailed study of the soil gases has revealed the fact that the gases escaping through and at the surface of the water in the paddy fields, are different from those that are present in the soil themselves and consist mostly of oxygen and nitrogen as against marsh gas, hydrogen and carbon dioxide that are formed in the soil. A certain relationship was also noticed between the evolution of and the presence or absence of crop, and pot experiments have clearly shown that the effect of the crop is to diminish the evolution of oxygen. This means that the evolved oxygen is absorbed by the crop for its growth. A careful examination of paddy roots of different types has shown that the roots of paddy do not resemble those of typical aquatic plants, but are similar to those of ordinary dry land crops and as such require oxygen to be healthy and strong. The supposition is, therefore, correct that the oxygen is used up by the crop for aerating its roots.

The evolution of oxygen has been traced to a film of algae commonly seen on the surface of paddy fields and this film is found to contain bacteria which oxidize hydrogen and marsh gas with production of carbon dioxide. The carbon of this gas is utilized by the algae for this food-liberating oxygen which dissolves in the soil water and aerates the roots.

If the oxygen dissolved in the surface water is to aerate the roots, the water charged with oxygen should be capable of reaching the root zone, and this is possible only if there is drainage; so that drainage is an important factor. If the soil is badly drained the oxygenated water cannot enter the soil and consequently aeration would be restricted to the surface layers.

On the other hand, in well-drained soils, the aerated water would penetrate deeper into the soil. Consequently it appears reasonable to presume that the better the drainage, the deeper would be the aeration and therefore a proportionately increased cropping. If this is the case aeration can be promoted by a thorough periodical draining of the soil.

Actual experiments have shown that this is not the case. The mere draining of the soil is inadequate for the purpose. The simple system of slow movement of water through the soil and therefore through the root range has been found to be most beneficial for the crop. The reason for this has been found to be that the water percolating through the soil is strongly charged with oxygen and therefore supplies plenty of it to the roots; whereas, the simple admission of air into the soil by thorough draining would yield only a weak solution of oxygen.

The best results are abtained with a moderate amount of drainage and too slow or too rapid drainage would result in decreased cropping. The reason for this has been traced to the fact that the development of the film which is responsible for the supply of oxygen occurs best under moderate drainage conditions. Thus the most efficient drainage in paddy soils is not the quickest but one that permits the surface film to maintain its full activity.

The practical aspect of these investigations from the point of view of the South Indian ryot is that the relationship of green manure to the aeration of roots is of the greatest importance and that, apart from all other considerations of manurial value or its influence on the texture of soil, one of the most important functions of green manuring with reference to paddy soils lies in promoting the activity of the surface film which is responsible for the proper aeration of the roots. We have also learnt that green manuring does not always give good results on all soils and that when drainage is deficient, the toxins produced during the decomposition of the green manure affect the growth of the crop adversely and that, therefore, green manuring should not be adopted as a universal practice but should be undertaken after careful consideration. The universal practice of puddling paddy soils has been understood and this knowledge has led to the conclusion that drainage can be controlled by means of puddling and that this is easily at the command of the ryot.

Another very important practical indication of these investigations is that growing a green manure crop in a field to which it has to be subsequently applied as green manure, is not advantageous as the nitrogen is largely dissipated as gas and as the crop had taken its nitrogen originally from the soil, it involves a distinct loss of nitrogen.

The work on paddy soils and the nutrition of the paddy plant has so far been considered. The work on the dietetic value of rice which forms the main food of a large section of the people of South India will now be considered. This investigation has its origin in a collaborative work of the chemical section with the Deficiency Diseases Inquiry into the relationship existing between rice and Beri-beri in India.

The problem of the relationship of rice to Beri-beri will not be specifically discussed here but certain aspests of the defects of polished white rice will be briefly considered.

Fashion is so contagious that even the poorest man is anxious to use highly-polished spotless white rice if he could only secure it. It is no exaggeration to state that the opulence and the extent of refinement of a man is partly measured by the quality of the rice he uses. Little do we know what valuable nutrient materials are lost in the polishing. The greater the polish, the greater is the loss. The fats, proteins, mineral salts and vitamins are stored in the outer dirty brown or red coating of the rice grain, and during the process of polishing these nutritive constituents are lost and all that remains is mostly starch.

Analyses in the laboratory and feeding trials with pigeons have shown that raw-milled, unpolished rice is the most nutritious, while raw-milled, highly-polished rice is the least nutritious. Parboiled rice comes midway between these two extremes. Parboiled and milled rice, in the unpolished stage, is not so nutritious as raw-milled and unpolished rice; but even when it is polished, boiled rice possesses a higher nutritive value than the corresponding raw polished rice.

Washing of rice just before cooking has also been found to deprive rice of a good deal of its most nutritious ingredients. The effect of draining rice after cooking should also be similar.

EMPIRE SPICES

THEIR PRODUCTION AND IMPORTANCE*

SPICES, like vitamins, might well be described as "accessory food factors." Although, generally speaking, devoid of any nutritive value, their judicious use serves to render food more palatable and to stimulate the digestive powers. In virtue of the essential oils which they contain, many spices exercise a useful carminative action and, moreover, possess valuable antiseptic powers.

Outside the industries in which spices are employed, their importance is perhaps, not as fully realised as might be desired. Apart from their use in the culinary arts, spices find many useful applications in the perfumery industry. Many are employed medicinally, whilst from some of them, valuable chemical products are obtained. In connection with this last application an extremely interesting and very important process, in which what is practically tantamount to the conversion of one spice into another is effected, calls for special mention. From the essential oil obtained from cloves a substance known as "eugenol" is isolated which, by appropriate chemical means, is converted into vanillin, identical in every way with vanillin obtained from vanilla pods, which is the chief odorous constituent of this spice. The process, which is essentially an English one, is also applicable to the essential oil of cinnamon leaf, and the vanillin manufactured by it is generally regarded as being superior to vanillin made on the Continent by a different process from guaiacol.

One naturally associates the cultivation of spices with the flowery and aromatic East. Whilst, however, the contribution of Asia to the spice markets of the world is very considerable, there are many important centres of spice production eleswhere. The British Empire is rich in spice-producing lands, and, in addition to India and Ceylon, mention must be made of Zanzibar, Sierra Leone, Seychelles and the British West Indies as important spice-producing colonies.

The Moluccas or Spice Islands, the home of both the clove and the nutmeg, were discovered by the Portuguese in the sixteenth century and in 1619 passed into the hands of the Dutch, who, in order to keep up prices, did all in their power to limit production. A similar policy was adopted by them in Ceylon, which at one time was the only country producing cinnamon, all excess of the spice over a certain stipulated amount per annum being burnt.

Naturally such a short-sighted policy could not continue unchallenged or for long persist. In the eighteenth century, the French were successful in smashing the clove monopoly, the spice being successfully introduced and cultivated in Mauritius. In the case of cinnamon, Ceylon passing into the possession of the British the spice remained a monopoly of the East India Company until 1833.

Cinnamon.—In any account of Empire spices, pride of place must, perhaps, be given to cinnamon, as being almost exclusively an Empire product. The spice consists of the dried bark or shoots of the Ceylon cinnamon tree, *Cinnamomum-zeylanicum*. There are other species of *Cinnamomum* trees possessing aromatic barks used as spices, chief of which are Chinese cinnamon or cassia, *Cinnamomum cassia*, and Javanese cinnamon, *Cinnamomum burmanni*. These, however, are quite

* By H. Stanley Redgrove, B. Sc., A.I.C. in *Empire Production and Export*, No. 158, October, 1929.

distinct from true cinnamon, both in flavour and other respects, and are less highly esteemed.

When growing wild, the Ceylon cinnamon tree has been known to attain a height of as much as 40 feet, but under cultivation it exists as a coppiced shrub. As already mentioned, its native home is Ceylon, which is the country where it is chiefly cultivated. It is also found in Southern India, and has been introduced into the Seychelles; but trees grown in the last-mentioned colony produce a spice inferior in flavour to those grown in Ceylon, and yield an essential oil of a very different character.

The essential oil of cinnamon bark is obtained by distilling the bark with water or steam, and is highly valued in perfumery for its delicious odour. It is also used as a flavouring agent and as drug. Oil distilled in England or on the Continent compares favourably with that distilled locally in Ceylon, as the latter is so often adulterated with oil obtained from cinnamon leaves. There would seem to be an opening for enterprise here, since, with modern plant operated under stringent conditions, it should be possible to produce locally an equal to that distilled in England and at a much lower cost.

The essential oil of cinnamon leaf, which is very unlike cinnamon bark oil and more closely approximates in character to clove oil, is, as already mentioned, an important source for the isolation of eugenol, from which vanillin is manufactured.

The following figures relating to the exports of cinnamon and cinnamon oils for the year 1928 will be of interest, as indicating the magnitude of the trade in these commodities. Ceylon: Cinnamon quills, 34,699 cwt.; cinnamon chips (used mainly for distillation), 11,114 cwt.; cinnamon bark oil, 9,122 lb.; cinnamon leaf oil, 36,397 lb. The quantity of cinnamon quills shows some increase over the amounts for preceding years, but the figures for the oils indicate a big drop. Seychelles: Cinnamon, 2,120 cwt.; cinnamon bark oil, 68 lb.; cinnamon leaf oil, 138,812 lb.; the exportations of cinnamon and cinnamon leaf oil both being on the upgrade. So far as India is concerned, the amounts exported are inconsiderable, the figures for the year ended March 31st being: Cinnamon, 49 cwt.; and cinnamon oil (nature unspecified), 310 lb.

Nutmegs and Mace.—It is, perhaps, not generally known that nutmegs and mace are products of one and the same tree, but such is the case. The tree in question, *Myristica fragrans*, is a native of certain of the Spice Islands, and was introduced into Ceylon in the early part of the nineteenth century. It is cultivated nowadays in a number of tropical countries, including the British West Indies, especially Grenada, which exported, in 1927, 21,238 cwt. of nutmegs and 3,733, cwt. of mace.

The nutmeg tree produces a fruit somewhat resembling a large apricot in appearance and colour. When ripe, the husk splits open, disclosing a glossy, dark-brown nut, enclosed in a peculiar netlike covering, or aril, which is of a scarlet colour.

The nuts and arils are separately dried. The dried aril constitutes mace; and the hard brown seeds, which are easily removed from the nuts, whose shells are thin and brittle, form the nutmegs of the shops. Before exportation, the nutmegs are often treated with lime as a preservative against the attacks of insects. They are graded according to size and condition, good specimens being sold as a spice whilst inferior ones may be sold as a ground spice or used for manufacturing either the distilled or expressed oil of nutmegs. The first is obtained by distilling the ground nutmegs with steam, and it is interesting to note, is much employed as a flavouring agent in the manufacture of dental creams and in the tobacco industry. The expressed oil, which is a solid fat, often erroneously called "oil of mace," is obtained by subjecting the nutmegs to hot pressure.

Cloves.—Turning our attention to cloves, this spice consists of the dried, unopened flower-buds of an evergreen tree, *Eugenia caryophyllata* a native of certain of the Molucca Islands, and as already indicated at one time only obtainable from this part of the world. Cloves have been and still are cultivated in many countries. For a period, Penang produced what were usually regarded as the finest cloves obtainable; but the cultivation of the clove in Malaya, which is in the hands of the Chinese, has sadly declined in recent years, and Malaya can no longer be seriously considered as one of the important clove-producing colonies.

On the other hand, clove-production in Zanzibar has made very satisfactory progress. In 1927, Zanzibar exported 249,453 cwt. of cloves and 49,209 cwt. of clove stems, as compared with 183,624 cwt. of cloves and 22,491 cwt. of clove stems for 1922. Cloves are also cultivated in Ceylon and India, but the amounts exported are quite inconsiderable. It is estimated that Zanzibar and the adjacent island of Pemba produce about nine-tenths of the world's supply of cloves. The chief foreign competitors are Madagascar (French) and the Dutch East Indies.

Clove trees are usually raised from seed, and require a rich, clayey soil free from damp. Picking the unopened flower-buds and drying them, both call for special care. On distillation with water or steam, they yield an essential oil, which is employed in the perfumery and confectionery trades and is also used medicinally. This oil also provided a source for the isolation of eugenol, to which reference has already been made.

Allspice.—Allspice is another Empire spice of which mention must be made. This is not, as might be thought from its name, a mixture of various spices, but a distinct spice, better called "pimento." It consists of the dried unripe berries of a small tree, *Pimenta officinalis,* which is a native of the West Indies and Central America. The name "allspice" is given to it because the flavour is supposed to resemble that of a mixture of cinnamon, nutmegs, and cloves. Jamaica, the chief producing centre in the British West Indies, exported 88,075 cwt. of this important spice in 1927.

Allspice, it may be noted, on distillation with water or steam, yields an essential oil, which is used to some extent in soap perfumery and in preparation of bay rum. The leaves of the plant also yield an oil when similarly treated. Both oils contain a considerable amount of eugenol.

Ginger.—No account of Empire spices would be complete without reference to ginger. This spice consists of the underground rhizomes of an herbaceous perennial, *Zingiber officinale*, which is a native of Tropical Asia, but is cultivated in many tropical countries, including so far as the British Empire is concerned, Jamaica and Sierra Leone, in addition to India where it has been grown for centuries. Ginger comes on the market in two main forms, peeled and unpeeled, of which the first is the more highly esteemed. The rhizomes are dug up after the aerial parts of the plant have dried in the sun, or, in the case of peeled ginger are washed, peeled with a narrow-bladed knife, washed again, and finally dried. Sometimes the ginger is parboiled before peeling. Jamaica ginger is usually peeled and the amount exported in 1927 was 24,905 cwt. being rather less than that for 1926, but in excess of amounts for preceding years. Until recently ginger from Sierra Leone was only roughly scraped, but a better quality peeled ginger is now exported by this colony and has been well received, not only in Great Britain, but also in the United States, Canada, and South Africa. The amounts exported show a steady increase up to 1926 (55,265 cwt.), but in 1927 the amount fell to 27,354 cwt. India also exports a very considerable quantity of ginger, the amount for the year ended March 31st, 1929, being 33,126 cwt.

The uses of ginger in the confectionery trade and also as a medicine are too well known to need more than bare mention. It may be added that, in addition to being, like other spices, a useful carminative, ginger is by no means devoid of nutritive value, as it contains a considerable proportion of starch.

Pepper.—Pepper, again, is another extremely important spice which is produced in the British Empire. Pepper is the berry of a vine-like climbing plant indigenous to the moist, low-country forests of Ceylon, South India and Malaya, and is extensively cultivated in India by both natives and Europeans, the amount exported by British India for the year ended March 31st, 1929, being 92,465 cwt. rather less than half that exported during the previous year. The plant thrives best in a hot, moist climate where there is a plentiful rainfall, and the trade in pepper is probably one of the oldest branches of commerce between Europe and the East. Certainly during the Middle Ages it was one of the most important.

The two main varieties of pepper, white and black, are both produced from the same plant, *Piper nigrum*, the difference arising from the stage at which the berries are plucked and the manner in which they are afterwards treated. Black pepper, which is the sort chiefly produced in India, is obtained by collecting the berries before they are completely ripe and drying them in the sun. White pepper, on the other hand, is obtained by soaking the ripe berries in water to bring about fermentation, after which the pulp is removed, a process usually effected by trampling the mass under feet. The fruits are then dried. White pepper is less pungent in flavour than the black variety.

It should, perhaps, be mentioned that long pepper, which is quite distinct from these, although somewhat similar to black pepper in taste and odour, is obtained from other species of pepper plant, especially *Piper officinarum,* cultivated in Java (Dutch).

In addition to those already dealt with, other spices are produced within the British Empire such as chillies, turmeric and cardamoms in India; vanilla, in very small amounts, in Dominica and Seychelles, as well as some others of less importance, about which considerations of space forbid details being given. Enough has been said, however, to indicate the position of first-class importance the British Empire occupies in the matter of spice production. Whilst that position can be viewed with pride, this is not to say that there is no room for improvement or further advancement. The possibilities of India as a spice-producing country have by no means been fully exploited; and, on the face of it, there seems to be no adequate reason why vanilla, the flavour of which is preferred for many purposes to that of artificially produced vanillin, should not be successfully cultivated on a large scale in the British West Indies.

WATER-AND-OIL TREATMENT AGAINST SOIL-INHABITING TERMITES AND ANTS*

PHILIPPINE termites of the genera *Coptotermes, Heterotermes, Termes*, and occasionally certain other forms, which build their nests under the ground, are injurious to posts and other wooden structures that are set in the soil or otherwise come in direct contact with it. There are also frequent cases of these ground-inhabiting termites laying their tunnels along cement walls of concrete buildings in order to reach the wooden floors and framework in the superstructure. The preventive measures recommended by various authors, namely, that of using metal strips or shields on concrete bases to isolate the upper wooden parts of buildings from the ground probably constitute the best and most dependable method of protection against subterranean termites; but unfortunately the practice is not feasible for general adoption in the Philippines. It would be applicable only in the case of the more expensive permanent structures. In houses in the average *Barrio* community, the primary consideration is cheapness, and the component parts are largely such short-lasting materials as bamboo, nipa, and rattan. Quite frequently, these buildings are very temporary affairs, and the owner cannot afford to set his posts on concrete foundations and put on extra appurtenances in the form of metal strips or shields. When the termites attack the posts or other parts of the building, as they invariably do, the damaged parts are replaced. More or less extensive repairs of this nature usually have to be made once a year or oftener.

Under such ideal conditions for termite attack wherein the stage is always set for infestation, damage may still be prevented or at least minimized by making regular and frequent inspection of the parts of the buildings in contact with the ground and promptly employing proper remedial measures. Ground-inhabiting termites betray their presence by the conspicuous tunnels of earth and other dark-coloured materials that they construct to cover their exposed runways on objects above the surface of the soil.

Paris green has in recent years come into vogue in connection with the control, both of subterranean and of wood-inhabiting termites in parts of the United States, Porto Rico and elsewhere. Paris green is placed along the runways of termites so that in their march some of the poisonous dust will adhere to the insects' legs and bodies. The idea is to take advantage of the termites' habit of licking one another's body, whereby they thus eat some of the adhering particles of the poison. The result is that even the young nymphs and the queen in the nest would ultimately be poisoned by the workers when they return home. The writer has made but limited trials of this method of control; the results have been either fair or indifferent. Possibly by following the recommendation of Smith of scattering the dust in the termite runways with a De Vilbiss atomizer No. 79 better results could have been obtained. It is intended to follow the work up in our laboratory.

During the past two years another method has been used by us in ridding the building which houses the Departments of Entomology and Plant Pathology, of underground termites which from time to time build

* From *The Philippine Agriculturist*, Vol. XIX, No. 9, 1931.

[illegible]

their tunnels up along the concrete walls to the wooden parts above. One of these species, which invaded the building in June, 1929, was *Coptotermes wastator* Light, a very destructive and not easily controlled pest. Repeated trials to locate the nest of that particular colony had failed, we had dug up the ground for a depth of one and one-half meters along the base of the wall where the tunnels had their connection, but without success. We had tried the Paris green method, we had fumigated the soil with a copious supply of calcium cyanide granules, but all to no avail. The other infestations were by species of *Termes* two of which occurred on the wooden posts of the garage which were set in the ground and the rest in the building proper, as in *Coptotermes*.

The procedure we finally adopted was as follows: A shallow trench was dug in the soil where the termite tunnels were connected. This was then filled with water until the soil was so thoroughly drenched that absorption became very slow. If the place was near a faucet, a rubber hose was used; otherwise water was carried in pails. Enough waste engine oil (such as that drained from the crankcase of motor cars) or kerosene was then poured into the trench to make a very thick film on the surface of the water. As the water soaked downward, the oil was drawn by surface tension under the ground and through the communication galleries of the termites into the nest. Previous trials with oil alone, without water, had failed because the oil did not penetrate into the soil well enough to reach the main termite colonies, and, beside the fact that more oil had to be used, the treatment resulted in merely shifting the direction of march of the ravagers.

In our trials with this method, both in the use of *Termes* and the persistent *Coptotermes* one treatment was found sufficient to destroy an entire colony. The day following the operation, tunnels were sometimes seen rebuilt on the walls, either partly or wholly, in their original location; but these were the work of the workers that had been caught in the upper parts of the building during the treatment and shut off from their nests by the oil. In some cases these tunnels continued to be rebuilt for two or three days, but after this period the last remaining representatives of the colony disappeared. Nests of *Termes* that were dug out a few days after treatment were found to contain only dead individuals. There has not been a single case or recurrence of infestation from the same source following each treatment.

The simplicity of the method, the ease in obtaining the materials used and at little or no cost, and its efficacy against subterranean termites are among its desirable features. The practice has been found to work with equal success on ground-inhabiting species of ants which are a frequent nuisance around houses and yards. When treating ants' nests, however, it was found unnecessary (and also decidedly inconvenient) to dig a trench. The ground in which the openings of the nests were located was merely soaked thoroughly with water before oil was added. More water was then poured so as to give the oil better distribution. Several coconut-shellfuls of water and a few tablespoonfuls of oil are all that are needed for treating an average ant's nest. Because of the injurious nature of mineral oils, the method should not, of course, be used if the nests are located at the bases of tree trunks or other valuable plants.

COFFEE CULTIVATION IN JAVA*

IN the eighteenth century and in the first half of the nineteenth century "Java coffee" (*Coffea arabica*) was cultivated on a large scale by the natives under the pressure of the Government. After 1870 this culture was also started by private people and companies working with European capital, and East Java became the centre of coffee growing in the Dutch East Indies.

This flourishing industry was brought to an end by the leaf disease (*Hemileia vastatrix*) which made its appearance in 1876 and quickly spread over the whole Archipelago. At present "Java Coffee" (*Coffea arabica*) is only to be found on some estates high up the mountains and is cultivated by the natives in some parts of the other islands (Bali, Sumatra, Celebes, Flores, Timor). At that time newly-imported Liberian coffee (*Coffea liberica*) seemed less susceptible to the leaf disease and was planted to a certain extent, but after a few years it began to be more and more attacked and at last it was also greatly devastated.

On many estates where arabica and liberica were cultivated next to each other, cross fertilisation took place and in the nurseries hybrids appeared among the seedlings. One of these, originated at the plantation "Kawisari," was especially considered worth cultivating and at present this hybrid is cultivated on a fairly large scale on different estates. It is a remarkable fact that this hybrid, originated from parents both very liable to leaf disease, is resistant.

The salvation of the coffee industry was the importation in 1900 of the "robusta coffee." This species proved to be very suitable for the conditions in the Dutch East Indies and it is at present one of the most important crop plants, both for the estates and for the natives. In 1927 and 1928 each of these two groups produced about 60,000 tons of coffee. The following figures show the export of the three kinds of coffee from the Netherlands Indies, grown on estates and by natives.

Coffee exports from the Netherlands Indies, in tons of 1000 kg.

	Estates			Native Farms			Total
	Arabica	Liberica	Robusta	Arabica	Liberica	Robusta	
1927	1000	800	62.000	6000	—	51,000	121,000
1928	900	600	52,000	6000	—	65,000	126,000

No figures are available as to the area of native coffee planted; the area under coffee on the estates amounted in 1925, 1926, and 1927 respectively to 116,530, 117,351, and 118,445 hectares. Of the area planted in 1927—69,311 hectares were not interplanted and 49,134 interplanted. With other crop trees Java had 95,042 hectares (the greater part, viz. 77,136 hectares in East Java) and Sumatra 21,032 hectares; only a couple of thousand hectares in the other islands. As regards the areas planted with each of the different kinds of coffee, 107,992 hectares were under robusta, 4,812 under arabica and 4,164 under liberica and a small area under other kinds of coffee.

* From *International Review of Agriculture*, Part 1, Year XXI, No. 10, 1930.

As regards disease and pests, robusta is not immune against leaf disease but it suffers little from it and its predisposition has not become greater in the course of the years as was the case with the liberica. More trouble is experienced from a small beetle, that bores into the berries and destroys the contents (*Stephanoderes hampei*). It has been introduced with coffee seeds from Africa. This pest is combated by harvesting at short intervals in order to remove the breeding places as soon as possible, and by keeping the soil clear of fallen coffee berries. In East Java where the crop is limited to a certain number of months and picking does not take place the whole year through, a further effective means of combating the borer is the removal after the crop of all berries still left over from blossomings of the year previous to the crop year. Besides the Government Institute for Plant Diseases imported from Africa a parasite wasp. This has been bred and distributed to the plantations, but up till now the wasp has not proved to be of much use.

In this and in many other problems much use has been derived from the co-operative efforts of the scientist and the practical planter. The scientific work is done by the staff of the Coffee Experiment Station, Malang, and the experiments on the plantations are done in close collaboration with the planter. Formerly it could be said that the planters merely followed in their fathers' foot steps but now they accept the advice of the scientists.

Owing to the practising of scientific methods in orchard work and on account of its cheap labour Netherlands Indies is, as regards coffee culture, in a strong position and may regard its future with equanimity.

One of the important measures which have reduced the cost price by increasing the production has been the use of green manures.

By a judicial use of shade trees the damage caused by heavy winds and also that caused by long droughts—as often occur in East Java—is avoided.

Improvement of the planting material is obtained by using seed of trees which excel in production and in other favourable characteristics, such as large-sized berries, and by this measure the present robusta trees are, taken as a whole, superior to those originally imported.

Robusta coffee is exported primarily to Holland—for more than one-fourth of the total—while almost as much is shipped to France. The United States, Singapore, and Spain are also important purchasers.

Of the native coffee industries in the Dutch East Indies, that of the island of Bali is very interesting. *Coffea arabica* is mostly cultivated, a small area is devoted to robusta coffee. The arabica culture began to get important in the middle of the nineteenth century. At present the exports amount to a yearly average of 2,000 tons. In consecutive years the yield varies much, as is always the case with arabica coffee; it varies from 1,400 to 2,800 tons. The native farms vary in size from 1 acre to 20 acres, a few have a larger area in coffee. One of the remarkable features of this native coffee industry is the judicious use of shade trees. While in other parts of the Netherlands Indies and in fact in many other coffee-growing countries natives generally dispense with shade trees—a system which gives on good soils, high yields during three or four years but a quick decline of the coffee after its fifth or sixth year—the Balinese people cultivate their coffee under dense shade of the "dadap" (*Erythrina lithosperma*). They are so convinced of the beneficial effect of the shade tree on the soil, that they plant the dadap on new land a few years before the coffee is planted, thus improving the soil beforehand.

When the coffee goes backward, the Balinese rejuvenate the fields by bending down the coffee trees and inducing them to make new watershoots; some of these at the base of the tree are left for making new stems and the old stem is cut down.

THE FOREIGN TRADE OF THE UNITED STATES OF AMERICA IN TEA IN 1930*

ANALYSIS OF STATISTICS COVERING IMPORTS AND RE-EXPORTS OF TEA

EACH year the important figures covering tea purchased by the United States from foreign lands tell the same story—stationary or decreased shipments and a consequent slight decrease in *per capita* consumption. The year 1930 was no exception to the rule. Tea imports totalled only 84,926,000 pounds as against 89,373,000 pounds in 1929. The total value of this trade fell off in about the same proportions, being $22,595,000 for the year just closed as compared with $25,866,000 for the year before.

This decrease, however, is entirely in the teas from Far Eastern sources. Those from the British Indies, both direct and transhipped through Great Britain and Canada, showed a fair gain in total volume, although lower prices brought the value down below that of 1929 except in the case of the comparatively unimportant transhipments through Canada.

Japan Relinquishes First Place.—Perhaps the most notable change in the trade last year was the relinquishment of first place among our foreign suppliers by Japan. That country has led all others for an indefinite number of years, and in 1929 it still maintained its position with total shipments to this country of 24,539,000 pounds. In 1930 this total fell to 20,948,000 pounds and was passed by that of the tea coming from Great Britain, which amounted to 22,830,000 pounds, nearly a million pounds more than in 1929. Shipments direct from Ceylon stood at 17,986,000 pounds having a value of $5,768,000 in 1930, a small increase in amount and a decrease in value from 1929. India's direct contributions also gained slightly, rising from 8,788,000 pounds valued at $2,530,000 to 9,506,000 pounds valued at $2,382,000 in 1930.

China Imports Drop 33%.—Tea imports from China continued their history of recent years by taking a sharp drop of some 33 per cent., the trade in 1930 totalling only 6,467,000 pounds as against a figure of 9,467,000 pounds in the preceding year. The value declined even more and fell below $1,000,000, the total of $975,000 comparing with $1,751,000 in 1929, a drop of almost 50 per cent. Tea from the Netherlands East Indies showed the same downward tendency, although the falling off from 5,051,000 pounds in 1929 to 4,766,000 pounds last year was comparatively small.

Including teas shipped through Canada and Great Britain, the total teas coming to the United States from British plantations in the East Indies amounted in 1930 to 50,811,000 pounds, having a total value of $16,179,000. This represented 60 per cent. of the total imports in point of volume, and about 70 per cent. in point of value.

Re-exports of tea, covering a multitude of small shipments to a large number of foreign countries but principally to Latin America, were 609,000 pounds in 1930, valued at $208,000—a fair gain over the 1929 trade in volume but a decrease in value.

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* From *The Spice Mill,* Vol. 54, No. 2, 1931.

TEA IMPORTS

	1929 Lb.	1929 Value
United Kingdom ...	21,923,137	$8,162,020
Canada ...	412,780	211,717
British India ...	8,787,873	2,529,784
Ceylon ...	17,534,645	6,209,054
China and Hongkong ...	9,467,287	1,751,223
Netherlands East Indies ...	5,050,898	1,390,622
Japan ...	24,538,932	5,151,753
Other Countries ...	1,657,622	459,916
Total ...	89,373,174	25,866,089

	1930 Lb.	1930 Value
United Kingdom ...	22,830,219	$7,809,157
Canada ...	489,497	219,897
British India ...	9,505,904	2,381,719
Ceylon ...	17,985,589	5,767,818
China and Hongkong ...	6,467,403	975,421
Netherlands East Indies ...	4,765,751	1,110,698
Japan ...	20,948,428	3,896,722
Other Countries ...	1,933,429	433,213
Total ...	84,926,220	22,594,645

TEA RE-EXPORTS

	1929 Lb.	1929 Value	1930 Lb.	1930 Value
Italy	...	...	75,020	$11,276
Canada	51,100	$20,270	32,398	11,106
Panama	87,205	30,430	69,893	24,930
Mexico	58,052	27,776	44,064	22,065
United Kingdom	42,022	11,058	116,759	28,534
Peru	74,615	35,026	54,990	21,979
Hongkong	7,143	1,832	52,017	11,850
Other Countries	217,556	95,359	164,105	76,312
Total	537,693	221,751	609,246	208,052

COCONUT STATISTICS OF MALAYA*

AREA IN 1930

	State or Territory	IMMATURE		Total Immature area (acres)	MATURE		Total mature area (acres)	Total (acres)
		On holdings of			On holdings of			
		Over 100 acres each	Under 100 acres each		Over 100 acres each	Under 100 acres each		
Federated Malay States	Perak	11,476	14,196	25,672	37,664	45,604	83,268	108,940
	Selangor	5,398	35,519	40,917	32,429	36,948	69,377	110,294
	Negri Sembilan	155	1,121	1,276	914	3,776	4,690	5,966
	Pahang	256	3,948	4,204	2,456	7,870	10,326	14,530
	Total F. M. S.	17,285	54,784	72,069	73,463	94,198	167,661	239,730
Straits Settlements	Singapore	—	—	—	3,159	4,841	8,000	8,000
	Malacca	—	2,330	2,330	—	10,255	10,255	12,585
	Dindings	893	1,696	2,589	1,764	2,177	3,941	6,530
	Province Wellesley	2,183	1,438	3,621	15,415	17,785	33,200	36,821
	Penang	308	359	667	2,936	9,923	12,859	13,526
	Labuan	—	1,958	1,958	—	1,238	1,238	3,196
	Brunei	—	681	681	—	689	689	1,370
	Christmas Island	—	—	—	—	19	19	19
	Total S. S.	3,384	8,462	11,846	23,274	46,927	70,201	82,047
Unfederated Malay States	Johore	428	32,622	33,050	2,873	129,127	132,000	165,050
	Kedah	361	8,453	8,814	492	17,382	17,874	26,688
	Perlis	—	1,434	1,434	—	2,527	2,527	3,961
	Kelantan	—	—	—	—	—	—	57,271
	Trengganu	—	—	—	—	—	—	25,000
	Total U. M. S.	—	—	—	—	—	—	277,970
Grand Total	Malaya							599,747

* From *The Malayan Agricultural Journal* Vol. XIX, No. 2, 1931.

THE FOLLOWING ARE THE FIGURES OF THE 1924 CENSUS IN MALAYA

Federated Malay States			Straits Settlements			Unfederated Malay States		
Perak	...	75,281 acres	Singapore	...	6,565 acres	Johore	...	92,500 acres
Selangor	...	62,117 ,,	Malacca	...	45,000 ,,	Kedah	...	27,550 ,,
Negri Sembilan	...	6,604 ,,	Dindings	...	6,000 ,,	Kelantan	..	70,900 ,,
Pahang	...	19,400 ,,	Province Wellesley	...	55,000 ,,	Trengganu	...	8,000 ,,
			Penang	...	15,000 ,,	Perlis	..	2,578 ,,
Total F. M. S.		163,402 acres	Total S. S.		127,565 acres	Total U. M. S.		201,528 acres
			Total Malaya 492,495 acres					

MEETINGS, CONFERENCES, ETC.

BOARD OF AGRICULTURE

ESTATE PRODUCTS COMMITTEE

Minutes of the Forty-ninth Meeting of the Estate Products Committee of the Board of Agriculture held at the Head Office of the Department of Agriculture at 2-30 p.m. on Tuesday, March 10th, 1931.

Present.—The Director of Agriculture (*Chairman*), the Director of the Tea Research Institute, the Chief Technical Officer of the Rubber Research Scheme, the Entomologist, the Agricultural Chemist, the Acting Mycologist, Sir Solomon Dias Bandaranaike, Messrs. N. D. S. Silva, C. A. M. de Silva, C. Rasanayagam, E. C. Villiers, H. D. Garrick, J. B. Coles, R. G. Coombe, J. Horsfall, S. Pararajasingham, F. R. Dias, C. Drieberg, L. F. Roundell, A. W. Warburton-Gray, J. Forbes, A. H. Reid, J. W. Ferguson, C. C. du Pré Moore, Gordon Pyper, R. Murdoch, R. P. Gaddum, C. Bourchier, F. A. E. Price, F. H. Griffith, G. B. Foote, G. Pandithesekere, and T. H. Holland. (*Secretary*).

Visitors.—Dr. C. H. Gadd, Messrs. E. J. Livera, V. Canagaratnam, N. D. Simpson, C. N. E. J. de Mel, J. Carson-Parker, R. Smerdon, G. Harbord, and Lt.-Col. K. D. H. Gwynn.

Letters or telegrams of regret of inability to attend were received from Sir Marcus Fernando, Mudaliyar S. M. P. Vanderkoen, Messrs. H. L. de Mel, L. G. Byatt, J. P. Blackmore, A. W. Ruxton, J. H. Titterington, B. M. Selwyn J. Sheridan-Patterson, Wase de Niese, G. Robert de Zoysa, and C. H. Wilkinson.

Members had been notified before the meeting that items four and eight were to be deleted from the agenda.

Before starting the business of the meeting, the Chairman alluded to the fact that no meeting had been held since July 1930, owing to lack of agenda. He attributed this partly to the prevailing depression and partly to the existence of Research Institutes for tea, rubber, and coconuts, to which problems on these crops were now often referred. In addition there had been a good deal of excitement over matters of taxation, and this was not conducive to an atmosphere of calm deliberation of agricultural problems. He proposed discussing the question of future meetings at the end of the agenda.

The Chairman then alluded to the question of tea tortrix returns. These returns were not in all cases coming in satisfactorily and he desired an expression of opinion from the tea industry as to the desirability of continuing these returns. He thought the returns had been useful in the past and might continue to be so. He proposed to refer to this question again at the end of the meeting.

The Chairman then touched on the future work of the Experiment Station, Peradeniya. A good deal of work had formerly been carried out by the Department which could now legitimately be referred to the Research Institutes for tea, rubber, and coconuts. Referring to rubber he pointed out that a considerable number of experiments were to be continued in the old rubber areas, while on the Iriyagama Division the work of testing Ceylon mother trees and certain imported clones was in progress. He

briefly alluded to the problems of the rubber industry and the directions from which an improvement could be looked for. The question of the study of new crops such as tung oil, chaulmoogra oil, croton oil, coffee, citrus fruits, etc. was assuming increasing importance. These crops were receiving attention on the Experiment Station and the Department was always ready to give any possible advice and help on such crops. With regard to tea, it was not intended entirely to abandon experimental work. The tea area was only twenty-one acres in extent and being somewhat steep, rocky and uneven was not suited to manurial and similar experiments. The land was suitable for pruning experiments. He proposed to discuss the question further at the end of the meeting. As regards coconuts very little work had been undertaken on the station but he hoped that the Coconut Research Scheme would soon be in a position to initiate experiments. The acquisition of the estate had been completed and the question of the erection of laboratories was now being considered.

AGENDA ITEM 1. CONFIRMATION OF MINUTES

The minutes of the last meeting, having been circulated to members, were taken as read and confirmed.

AGENDA ITEM 2. PROGRESS REPORTS OF THE EXPERIMENT STATION, PERADENIYA

Reports for July and August 1930, September and October 1930, November and December 1930, and January and February 1931 were in the hands of members. The Chairman invited comments on these reports.

Mr. Foote expressed concern at the proposed reduction in rubber experimentation in view of the fact that the Rubber Research Scheme had at present no opportunities for experimentation. He enquired the date of commencement and period of duration of the rejuvenation experiment as originally planned. He enquired further whether figures were available of the incidence of brown bast in the change-over experiment.

Mr. Holland explained that the cutting out of rubber proposed would result on the old experimental area in a reduction of the area under this crop to 38 acres, and that except for the rejuvenation experiment no experiment was being cut short. The area under the rejuvenation experiment was divided into four plots—according to the original plan, plot 1 was to be tapped to death in one year, plot 2 in two years, plot 3 in three years and plot 4 in four years. The experiment was started on September 1st, 1929. Only the tapping of plot 4 would be cut short and he considered that ample information as to the results of the method of tapping employed in that plot would be available in three years. The idea of re-planting was abandoned but he did not consider the area suitable for this purpose as the number of trees per acre was irregular and small. Figures of brown bast incidence in the change-over experiment could be made available and he promised to furnish these.

Mr. Foote remarked that it was proposed also to cut out the rubber in plots 151-154.

Mr. Holland said that this was the poorest rubber on the station and that even when this block was cut out there would still be 38 acres left.

Mr. Foote, in alluding to the yields of budded rubber in plot 165, remarked on a statement in the report that it had been stated in the F.M.S. that when the tapping cut was approaching the point of union of stock and scion the yield of latex was negligible. He enquired if there was any scientific explanation to support this statement.

Mr. Holland replied that he believed he had taken the statement from Summers' book. He agreed with Mr. Foote that the yields in plot 165 did not appear to confirm the theory.

The Chairman remarked that a great deal was still to be learnt about the junction of stock and scion and the influence of the one on the other.

Mr. Foote then alluded to a theory that the upward growth of the stock resulted in the junction of stock and scion being raised to a greater height than at the time of budding, and that budding should be done below ground level.

Mr. Holland said that the trees in plot 165 did not bear out such a theory, the lower end of the sloping line of junction was in most cases near the ground level. He remarked that the ground level often altered.

Mr. O'Brien said that there was no support for the theory that the point of junction would be raised to any extent by the upward growth of the stock.

In connection with rubber experiments, at the Chairman's request, Mr. Holland outlined an experiment which it was intended to carry out on the Iriyagama Division on some trees which could not be included in an area for testing of clones. This was to bud a number of known stocks high up with buds from proved clones and subsequently to tap both stock and scion with the object of noting whether the scion influenced the yield of the stock.

Dr. Norris enquired the probable date of publication of the Manual of Green Manuring which had been alluded to in one of the progress reports.

The Chairman replied he was afraid there must be delay on account of work in preparation for the New Constitution at the Government Press. The Manual was ready for the press but he was informed that there was no chance of getting it printed till after April.

Mr. E. C. Villiers enquired if, in view of the congestion in the Government Printing Office, the Manual could not be printed by a private press.

The Chairman replied that being a Government publication he was afraid that this could not be done, but it might be possible to first publish the Manual serially in *The Tropical Agriculturist.*

This suggestion, however, was not adopted by the meeting.

Mr. Horsfall enquired if it was known at what elevations tung oil trees could be grown in Ceylon.

The Chairman replied that they would grow from sea level to the elevation of Peradeniya but information was lacking as to higher elevations.

Mr. Holland emphasised the necessity of distinguishing between *Aleurites Montana* and *Aleurites Fordii.* The former flourished in a tropical climate but the latter preferred a climate with definite cold season.

AGENDA ITEM 3. PROPOSED INVITATION OF DR. SNYDER TO CEYLON

Mr. R. G. Coombe said that it had been ascertained that Dr. Snyder, the termite expert of the U.S.A. Government, was to visit India in the near future. In view of the serious nature of the damage done by termites, both to agricultural crops and to buildings in this Island, he thought it would be an excellent thing if Government could be approached with a view to obtaining the permission of the Government of the United States for Dr. Snyder's visit to be extended to Ceylon.

Mr. Jepson gave a brief account of the damage now being done by termites which he considered was more serious than was generally realised. Over fifty species of trees were now known to be attacked and the list was growing almost daily. He showed specimens illustrating the damage done by termites.

Mr. Garrick alluded to a case of which he and Mr. Jepson were aware in which the Paris green treatment had been wrongly applied, and suggested that it might be advisable for Mr. Jepson to issue a general warning in the matter.

Mr. Jepson said that in the case alluded to by Mr. Garrick the Paris green had been injected into unattacked bushes with an idea that the injection might prevent attack. In some cases branches so treated had died. The error had been pointed out to the superintendent and he did not think it was likely to recur.

Mr. R. G. Coombe then proposed the following resolution: "That in view of the widespread damage already caused in Ceylon by termites, and the evidence that such damage is likely materially to increase, Government be asked to approach the Government of the United States with a request that Dr. Snyder should be permitted to visit Ceylon before his return to the States to advise regarding termites and their control."

The resolution was seconded by Sir Solomon Dias Bandaranaike and carried *nem con.*

AGENDA ITEM 5. REPORT OF THE SOIL EROSION COMMITTEE

The Chairman suggested that since the report had only been published a short time and members had not had opportunities for obtaining copies and studying the report, the discussion should be postponed till the next meeting.

This was agreed to.

Some enquiries were made as to the method of obtaining copies of the report and how the findings of the Committee were to be made public.

The Chairman said that the copies of the report could be obtained from the Government Record Office at a cost of Re. 1-10.

Mr. Haigh (Secretary of the Soil Erosion Committee) also mentioned that orders for large numbers of copies had been received by him from the Ceylon Estates Proprietary Association and the Low-Country Products Association, while one firm of agents had ordered six copies. These orders had been passed on to Government.

AGENDA ITEM 6. BLACK BEETLES AND DAMAGE TO COCONUT CROPS

The Chairman said that this item stood in the name of Mr. H. L. de Mel who was unable to be present. Mr. De Mel would doubtless address the next meeting on the subject but meanwhile he desired to make a few remarks as to the current conception that black beetles bred largely in coir fibre dumps. The investigations of the scientific officers of the Department had so far shown that the black beetles did not breed in such dumps. Leaving leafy matter lying about or burying it in shallow trenches might result in the breeding of beetles. Any such material should be buried deep and covered with sand, or soil not rich in humus. He read a short memorandum on the subject of breeding grounds of beetles.

Mr. Warburton-Gray enquired if the Plant Pest Inspector, Kurunegala, had left any notes about the breeding of beetles in buried green manure loppings.

The Chairman said he was not aware of any such notes.

Dr. Hutson said that it had been found that where the stems of the green manure plants were buried, breeding was likely to occur and that it was advisable to strip off the leaves of the plants before burying.

Mr. Panditheseker e said that a bad infestation of beetles had occurred when large fibre dumps had been present but when these had been buried, the infestation ceased.

Mr. C. A. M. de Silva supported the view that the beetles bred in coir fibre dumps. He further added that he did not believe in the burial of green coconut leaves, but when calcium cyanamide and ephos phosphate had been added breeding was not found to occur.

Mr. Warburton-Gray said that the beetles did not breed in fibre dumps.

Dr. Hutson said he had recently inspected about ten large fibre dumps in the Madampe district and he definitely asserted that the black beetles were *not* breeding in these dumps. It was possible that a few beetles might sometimes breed on the edges of the dumps. Cockchafer grubs were also sometimes mistaken for the grubs of the black beetle.

The Chairman said he wished to dispel the idea that the black beetle bred in these fibre dumps. The investigations of the scientific officers of the Department showed that this was not ordinarily the case. The presence of beetles should not be taken as evidence that they had bred in coir fibre dumps.

Mr. C. A. M. de Silva pressed for a more rigorous enforcement of the Plant Pest Ordinance in respect of the breeding grounds of black beetles.

The Chairman said that if essential, the Ordinance would be rigorously enforced but he preferred methods which aimed at the education and instruction of coconut growers.

Mr. Panditheseker e said that where road sweepings were buried beetles were always found but they were not found in buried coconut husks.

AGENDA ITEM 7. COTTON CULTIVATION IN ANURADHAPURA AND THE WANNI HATH PATHU AND THE EXTENSION OF COTTON CULTIVATION IN THE DRY ZONE

In the absence of Mr. De Mel, the discussion on this subject was postponed till the next meeting.

Mr. Drieberg read two extracts from the press which tended to create the impression that cotton cultivation could be successfully carried on in the wet zone and suggested that such an impression should be counteracted.

The Chairman said that he took it that only the growing of cotton on a very small scale was referred to and he did not think there was any need to interfere.

AGENDA ITEM 9. DISEASE OF TEA IN NYASALAND

The Chairman said that this question had first been brought up by the American Consul as a result of a report by the American Trade Commissioner in Nyasaland. A copy of this report had been sent to Mr. Leach, the Mycologist in Nyasaland, who reported that unnecessary importance had been given to the matter by the American Trade Commissioner and that there was no cause for alarm. The Mycologist was of the opinion that the disease alluded to existed in Ceylon but was not of any great importance,

Mr. Bertus gave a description of the disease which had already been described as witches broom disease.

Dr. Gadd said that the identification of a disease from a description, particularly a description by a layman, was always difficult. Butler had described the disease in Nyasaland and had thought that it probably existed in the east but it had been confused with *Diplodia*. Dr. Gadd agreed that the disease existed in Ceylon but not that it was confused with *Diplodia*. The disease must be included among the group of diseases known as witches broom disease. Park had first described witches broom disease but stated that it did not spread. The American Trade Commissioner had described a yellowing of the leaves. Dr. Gadd said there was a type which spread but that one was not associated with a yellowing of the leaves. Another type had been described by him as Chlorosis and this type of the disease did not spread.

At the conclusion of the business on the agenda, the Chairman brought up for discussion the question of the number of meetings to be held annually. After some discussion, Mr. Coombe voiced the opinion that the shortage of subject for the agenda had been mainly due to the hard times through which they were passing. He thought that the good attendance and lively interest shown in the day's proceedings indicated that the Committee was very much alive and he deprecated any suggestion of a reduction in the number of meetings. If agenda was lacking meetings could be postponed.

This view met with the approval of the meeting and the suggestion to request the amendment of the Ordinance with a view to a reduction in the number of meetings to be held annually was dropped.

Mr. C. A. M. de Silva suggested that the rule by which a member vacated his seat, if he failed to attend half the meetings held in a year, should be enforced.

The question of tea experimentation at Peradeniya was then discussed.

Mr. Foote suggested the appointment of a small Committee to discuss the matter with the officers of the Tea Research Institute. The Chairman asked Dr. Norris for his views on this suggestion.

Dr. Norris said that he was not aware that the matter was to be brought up and he would prefer to express an opinion at a later date.

It was decided that the matter should be brought up at the next meeting.

The question of tea tortrix returns was then discussed.

Mr. J. W. Ferguson considered that the present mild incidence of tea tortrix was largely due to the collection of egg masses which had had a good effect. He said that the collection undoubtedly increased the cost of plucking and with the present desire for economy there was considerable reluctance to continue collection. He considered however that the discontinuance of the measures in force would be very poor economy and strongly advocated maintaining the present arrangement.

The Chairman hoped that the ventilation of the matter might result in greater interest in the collection of egg masses and regular forwarding of returns.

The meeting then terminated.

T. H. HOLLAND,
Secretary,
Estate Products Committee.

TEA RESEARCH INSTITUTE

MINUTES OF LAST BOARD MEETING

Minutes of a meeting of the Board of the Tea Research Institute, held at the G.O.H., Colombo, on January 29th, 1931.

Present: Mr. R. G. Coombe (Chairman), Hon. the Colonial Treasurer, the Director of Agriculture, Hon. Mr. D. S. Senanayake, Mr. A. G. Baynham (Chairman, P.A. of Ceylon), Major J. W. Oldfield, Major H. Scoble Nicholson, Messrs. J. D. Finch Noyes, John Horsfall, T. B. Panabokke, R. R. Muras (Assistant Secretary), A. W. L. Turner (Secretary), and by invitation Dr. R. V. Norris (Director, T.R.I.), and Mr. J. Carson-Parker (Chairman, Uva P.A.). Messrs. F. F. Roe and Jas. Forbes (Jnr.), were unable to be present.

Before proceeding with the business of the meeting, the Chairman referred to the death of Mr. A. O. Whiting, who was Secretary of the Ceylon Association in London and had done a great deal of work on behalf of the Institute. A vote of condolence was recorded.

Minutes of the meeting of the Board of the Tea Research Institute of Ceylon, held on October 1st, 1930, and of the joint meeting of the Finance sub-Committee, Estate sub-Committee and Experimental sub-Committee held on November 22nd, 1930, were taken as read and confirmed.

The Chairman explained that the statement of accounts as at December 31st, 1930, which had been sent to all members of the Board on January 24th, 1931, was not the final statement for the year, a supplementary account would therefore be issued later.

It was decided that depreciation account be opened forthwith and an annual allowance of 10 per cent. on machinery and 5 per cent. on buildings credited thereto. The accounts were passed without further comment.

The Chairman announced that the increase in Tea Cess was published in the *Government Gazette* on November 14th, 1930.

After discussion and some amendments, the estimates for 1931 were unanimously approved by the Board.

It was decided that the new Government rates should apply to the travelling expenses of members of the Board and Scientific Staff from January 1st, 1931.

Votes of thanks to Messrs. G. R. Whitby and D. S. Cameron for their services as members of the Board were recorded.

The Chairman announced that the new laboratories at St. Coombs Estate were occupied by the staff on December 15th, 1930.

The Chairman announced that 4 each of the bungalows for the members of the senior and junior scientific staff were now being occupied. A further two junior bungalows would be shortly completed and ready for occupation.

TEAS FOR THE LONDON MARKET

Referring to the resolution passed at the last meeting, the Chairman said that the samples of teas had been sent to London. These had been submitted to nine London firms for valuation and report. Very satisfactory reports had recently been received, indicating that the teas were suitable for the home trade requirements.

SCIENTIFIC STAFF

The Board confirmed the increment due to the Entomologist as from the 9th December, 1930, which had been sanctioned by the Chairman. Reported that Dr. Evans' leave would take effect as from the 11th March, 1931. An application from Dr. Gadd for three months' vacation leave from Ceylon on urgent personal affairs was sanctioned. The Agricultural Chemist's application for 9½ months' leave from the 30th December, 1931, was sanctioned.

The following appointments were announced: Research Assistant, Agricultural Division, Mr. C. A. de Silva; Field Assistant to the Agricultural Chemist, Mr. M. Piyasena; Junior Assistant, Department of Physiology, Mr. O. J. Welaratne.

On the proposal of the Colonial Treasurer the amended rules for the Provident Fund for the subordinate staff were adopted.

The Chairman explained that at present there was a Finance sub-Committee, an Experimental sub-Committee, and an Estate sub-Committee.

He suggested that the Experimental and Estate sub-Committees should be amalgamated and designated the Experimental and Estate sub-Committee. This was agreed to.

The following were elected to serve on these sub-Committees:

Finance sub-Committee: The Chairman, T.R.I., Chairman P.A. of Ceylon, Chairman, C.E.P.A., and Director, T.R.I.

Experimental and Estate sub-Committee: The Chairman, T.R.I., Director, T.R.I., Agricultural Chemist, T.R.I., Visiting Agent, the Superintendent of St. Coombs, Messrs. John Horsfall and Huntley Wilkinson.

The Chairman reported that as a result of reports received of the marked increase of Nettle Grub in the Passara district he had visited the estate, where the pest was most prevalent, with the Director and the Mycologist. As a result of this visit he considered it imperative that further arrangements should, if possible, be made to cope with the pest.

The Director mentioned that though the estate referred to by the Chairman had provided a bungalow for Mr. Austin, it was not big enough if the work were to continue for any length of time. Further accommodation would be required for the laboratory and insectory and also for the additional staff it was hoped to provide for this work. These additions would be capital expenditure and it was a question whether the Institute should bear the cost.

The Chairman proposed that the Institute should not undertake any capital expenditure with reference to this and similar investigations but would be quite willing to provide the necessary scientific staff. This was agreed to.

The Chairman stated that he had been informed that Dr. Snyder from the U.S.A., had been engaged to investigate Termites in India. He considered that an effort should be made to get Dr. Snyder to visit Ceylon officially as well.

It was decided to circulate the papers in this connexion to the members of the Board for their views thereon.

COMMISSION ON PADDY CULTIVATION

MINUTES OF THE FIRST MEETING HELD ON MARCH 18TH, 1931

1. A meeting of the Commission was held in Committee Room No. 3 in the Council Chamber, Colombo, on Wednesday, March 18th, at 10 a.m.

The following members were present: The Hon. Dr. W. Youngman, Director of Agriculture (Chairman), Hon. Sir H. M. Fernando, Hon. Messrs. D. H. Kotalawala, E. R. Tambimuttu, H. R. Freeman, G. E. Madawela, the Director of Irrigation, Messrs. A. L. J. Croos Da Brera, H. L. de Mel, C. Drieberg, L. Lord, J. H. Meedeniya, T. B. Panabokke, R. C. Proctor, J. C. Ratwatte, L. McD. Robison, Mudaliyar W. A. Samarasinghe, the Divisional Irrigation Engineer, W.D., the Registrar, Co-operative Credit Societies, with Mr. J. C. Drieberg (Secretary) in attendance.

The following members were unavoidably prevented from attending the meeting: Hon. Messrs. K. Balasingham and W. A. de Silva, Sir Stewart Schneider, Messrs. A. W. Winter and K. Kanagasabai.

2. In his opening remarks, the Chairman drew attention to the purpose of the Commission, namely to make recommendations to assist the paddy industry and to improve the conditions under which it was carried on, and said that it would be competent for the Commission to advise on any means to effect these ends. Certain terms of reference for this purpose were given them.

The Chairman suggested the formation of four Sub-Committees as indicated in the terms of reference, the membership of each being 7 with the Chairman as an ex-officio member of all the Sub-Committees. The Secretary would be at the disposal of any of the Chairmen at any time.

Each Sub-Committee would select its own Chairman, with a view to keeping the several Sub-Committees up to strength and in order that it may be possible for any members whose services would be helpful on more than one Sub-Committee to serve in another group, the Chairman suggested he be empowered to add two additional members to each sub-Committee as necessity arose.

At the conclusion of their duty the Sub-Committees would report to the General Commission which would decide in full meeting upon the points presented by each.

The desirability of arriving at conclusions in a reasonable time was stressed, and the Chairman further drew attention to the necessity of indicating some order of importance in which the findings of the Commission should be taken up.

3. After discussion it was agreed that:

(1) Communications and transport should be linked to irrigation and drainage;

(2) Village irrigation works should not be separated from major irrigation works, inasmuch as they all formed one system;

(3) That credit and marketing should go together with tenancy conditions;

(4) The number of Sub-Committees should be reduced to three.

To a suggestion that item 6 of the terms of reference was a small one, the Chairman said that the importance of rural education would be seen at the end when the recommendations of the Sub-Committees were being considered in full Commission, as it was through this means that many of the ideas in the conclusions could possibly be given effect to.

Proposed by Mr. Ratwatte and seconded by Mr. Madawela that three Sub-Committees be formed, dealing respectively with items 1, 2 and 4; items 3 and 5; and item 6.—Unanimously carried.

The following proposals were unanimously agreed to by the meeting:

(1) That the Sub-Committees should, in the first instance, consist of 8 members;

(2) That the Chairman should be a member of all the Sub-Committees;

(3) That the Chairman be empowered to nominate two members to any Sub-Committee, if necessary;

(4) That the Chairmen of Sub-Committees would best be unofficial members.

4. With regard to the suggestion that travelling should be curtailed as much as possible, the Chairman said that the point would be borne in mind, but it should be left to the sense of the Sub-Committees.

Sir Marcus Fernando enquired whether the question of malaria in the paddy-growing districts would not be considered, and agreed to abide by the suggestion of the Chairman that it be dealt with at the end by the full Commission under general recommendations necessary to assist the paddy industry.

Any other general matters such as customs and measures which acted oppressively on cultivators, raised by Mr. Proctor, would be dealt with in like manner.

Mudaliyar Samarasinghe raised the question of the economic aspect of paddy cultivation, and was assured by the Chairman that it would be considered by the Sub-Committee on credit and marketing and not be lost sight of by the Commission as a whole.

5. The formation of the Sub-Committees was next dealt with by members stating on which Sub-Committee each desired to serve. Of the members present 8 expressed willingness to serve on Sub-Committee A, 7 on Sub-Committee B, and 3 on Sub-Committee C. Of the absent members, Sir Stewart Schneider was placed on Sub-Committee B, and Mr. W. A. de Silva on Sub-Committee C.

The Chairman stated that he would deal with the cases of Messrs. Balasingham, Winter and Kanagasabai.

To complete Sub-Committee C the meeting was requested to select 4 members from amongst those present, and Sir Marcus Fernando, Mr. Proctor, Mr. Meedeniya and Mr. Freeman, being proposed and seconded, were accordingly appointed. At this stage the composition of Sub-Committees was as follows:

Sub-Committee A—dealing with *Irrigation and Drainage, Communications and Transport.*—The Director of Irrigation, the Divisional Irrigation Engineer, Hon. Messrs. Madawela, Tambimuttu, Freeman, Mudaliyar Samarasinghe, Messrs. Panabokke, Proctor, the Chairman.

Sub-Committee B—dealing with *Tenancy, Credit and Marketing*: The Registrar, Co-operative Societies, Messrs. Lord, Croos Da Brera, Sir H. M. Fernando, Hon. Mr. Kotalawala, Messrs. Ratwatte, Meedeniya, Sir Stewart Schneider, the Chairman.

Sub-Committee C—dealing with *Rural Education*.—Messrs. Robison, Drieberg, de Mel, Hon. Mr. W. A. de Silva, Sir H. M. Fernando, Messrs. Proctor, Meedeniya, Hon. Mr. Freeman, the Chairman.

6. It was agreed that:

(1) The election of Chairmen be left to the respective Sub-Committees;

(2) A meeting of each Sub-Committee be held before the elections to the New State Council took place.

7. The Chairman said that it would not be necessary to fix a date on which the Sub-Committees should present their reports but that if delay occurred the attention of the Commission would be drawn to it.

It was not considered necessary to decide upon a quorum for Sub-Committees, but this point was to be borne in mind by them.

To a question by Mr. Tambimuttu, the Chairman stated that meetings of the full Commission would be held whenever necessary while the Sub-Committees were proceeding with their work.

In regard to literature, the Chairman requested members to communicate with the Secretary, whose special duty it would be to obtain all necessary documents. In this connection Sir Marcus Fernando drew attention to the scheme of vernacular agricultural education issued by a Committee in 1911 or 1912.

The following dates were fixed for meetings of the Sub-Committees:

Sub-Committee A on Friday 10th April at 11 a.m.;

Sub-Committee C ,, ,, ,, ,, ,, 2-30 p.m.;

Sub-Committee B ,, ,, 17th April at 11 a.m.

J. C. DRIEBERG,
Secretary,
Commission on Paddy Cultivation.

Peradeniya,
25th March, 1931.

DEPARTMENTAL NOTES

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA

FOR THE MONTHS OF JANUARY AND FEBRUARY, 1931

TEA

IN the report for September and October, 1930, a summary of the future plans of the station was given. It was stated that at the conclusion of the trial of *Indigofera endecaphylla* at the end of September, 1931, it was proposed to divide the tea area into two fields. As all the plots used in the above trial are included in the future field No. 1, and as no experiment is in progress in the plots which comprise field No. 2, the plucking of the latter plots as one field was started from January 1st, 1931. Owing to shortage of funds there is no immediate prospect of progress in the work of holing and planting up the strips which now divide the existing plots.

A further thinning out of *Albizzias* was carried out in plot 150. One more thinning will be necessary in a year or two.

During the drought in February the poor appearance of tea in the half-acre tea plot under *Albizzia chinensis* (*stipulata*), which was affording a negligible shade at the time, compared with adjacent tea under a much denser shade of *Gliricidia* was the subject of comment. This is a subject fully discussed in Section II of Manual of Green Manuring which is awaiting publication.

RUBBER

The tapping experiments in the Hill-top and Hill-side rubber were brought to a conclusion on December 31st, 1930. A final report on these experiments will be included in the next report. For the time being tapping has been stopped in both blocks in order to release labour for the other essential work to compensate for the reduction in the labour force rendered necessary by the reduction in funds allocated to the station.

In plots 151 to 154, where the rubber is to be eradicated after September, 1931, to make way for citrus, a new tapping to death experiment has been decided upon to run from April 1st to September 30th, 1931. This experiment is designed to clear up doubt as to the cause of the rapid drying up of cuts which has occurred in the rejuvenation experiment now in progress. There are 364 trees available and 91 trees will be allotted to each of the following treatments :

1. Alternate day tapping on one cut on the half circumference (control). Bark consumption 3 inches for 6 months.
2. Daily tapping on two cuts to the wood. Cuts one above the other. Bark consumption 6 inches for 6 months.
3. Alternate day tapping on two cuts to the wood. Cuts one above the other. Bark consumption 3 inches for 6 months.
4. Daily tapping on two cuts—ordinary tapping, not to the wood. Cuts one above the other. Bark consumption 6 inches for 6 months.

Tapping tasks to be changed round monthly.

CACAO

A large number of cacao trees have died during the past year. It is thought that the advanced age of this cacao may be partly responsible, but the immediate cause can usually be traced to bark canker which was very bad last year. This old cacao is overcrowded, and the fact that owing to pressure of other work no pruning beyond the removal of dead wood was undertaken in 1930 has possibly resulted in increased disease incidence. A considerable amount of labour has been employed in the period under review in digging out and cutting up these dead trees as well as in cutting up dadaps blown down in the recent strong winds.

At the conclusion of the present cacao manurial experiment at the end of March, 1931 it is proposed to simplify the organisation of the cacao areas by dividing them into ten blocks in place of the numerous existing plots. This scheme is detailed below :

Number of old plots.	Names of new blocks.
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, Tundu A ...	Cattle shed block
107, 108, 109, 110, 111, 94, 95 ...	Centre block
112, 113, 114, 115, 116	Muniandy block
117, 101, 100, 99, 98	Hillside cacao block
140 B	Temple block
119	Office block
"B" cacao	"B" cacao
88, 89, 90 91, 92, 93	Totadeniya block
Tundu B	Tundu B block
134	Saibo's block

The following scheme of pruning is proposed for 1931 and following years :

1. In the centre block the trees are to be heavily pollarded. The dadap shade will not be lopped this year in order to minimise loss from exposure of branches to the sun. Each tree will be treated on its own merits. A certain amount of thinning of cacao trees will also be done in this block. The above treatment will not take place before April 1st, at the termination of the cacao manurial experiment.

2. In the Hillside cacao block a gradual rejuvenation of the trees by allowing selected suckers to grow up is to be undertaken. The procedure this year will be as follows :

   (a) If the tree has one old stem and two young stems (grown up suckers), the old stems will be cut down and another sucker left to grow up so as to have three new stems.

   (b) If there are two old stems and one young stem, one of the old stems will be cut down and a sucker allowed to grow in its place.

   (c) If there are three old stems, one will be cut down and a sucker allowed to grow in its place.

   (d) If there are more than three old stems all except two will be cut down and one sucker will be allowed to grow.

3. All the other blocks will receive the same style of pruning as has been carried out in recent years, but slightly more drastic because no pruning beyond the removal of dead wood was done last year and the trees are now undoubtedly too dense. These blocks will act as controls for treatments 1 and 2.

It is proposed to record the yields and proportion of good and black cacao from these three treatments graphically over a number of years.

FODDER GRASSES

Four swampy paddy plots in the Panchikawatte fields have been drained with a view to planting up with Guinea grass during the next rains. When these plots are planted, about half the area of the old Panchikawatte paddy fields will be under fodder grasses.

TUNG OIL

In the block devoted to *Aleurites montana* in the Terraced Valley additional holes have been dug between the existing holes which, having been originally planted with *Hydnocarpus whightiana*, are spaced 25 feet from each other in the terraces. In addition, some new terraces have been dug, and there are now sufficient holes to accommodate the plants which are coming on in pots. Germination of *Aleurites montana* seed has been found to take from 6 weeks to two months but thereafter the plants have made vigorous and healthy growth.

The block devoted to *Aleurites* is still capable of further extension as plants become available.

GENERAL

The Tamil School which was formerly held in part of the implement shed has been re-opened in the old rubber room, which has been cleared and converted to this purpose. A new teacher has been appointed and attendance is good.

THE IRIYAGAMA DIVISION

A new area (area 4) has been laid out on the plan. It will contain eleven clones with H2 as control as usual. The trees growing in the land to be used for this area have been uprooted and the holes re-dug. Budwood of the eleven clones for this area is available in the nurseries.

A small block of 136 trees which lies to the south of area 1, and which is cut off by a road and therefore could not be included in a fresh area, was budded in the field with P.B. 23 at the end of December; spare plants were budded in the nursery. It was not thought that the time was a good one for budding and the percentage of success obtained in the field was very low. Fair success was obtained in the nursery. As plenty of budwood was available failures in the field were re-rubbed at once. Any further failures will be replaced by budded stumps from the nursery about April.

In the November-December report figures are given of the number of stumps in each clone of area 3 of which the buds had shot exactly five months after original budding. It was stated in that report that two clones

had not yet completed the five months period and for easy comparison the figures for all the clones are here given :

Clone.				Percentage of buds shot five months after original budding.
Heneratgoda	2	...	...	64·6
,,	401	...	...	31·3
,,	439	...	...	83·0
,,	203	...	...	81·5
,,	47	...	...	68·4
,,	24	...	...	73·5
Udapola	24	...	...	58·0
Milleniya	162	...	...	50·0
Hillcroft	34	...	...	75·0

Weather conditions were very similar for each clone and the large differences found indicate the possibility of quick shooting being a clonal characteristic.

In the nursery budding for area 2 where in each clone half the buds were put on to their own stocks and half on to ordinary mixed stocks no significant difference was found in the number of successes obtained. The percentage on own stocks was 92·7 and on mixed stocks 88·6. Measurements of the young budded trees at a later stage may reveal a difference in growth.

During the drought in February all plants in areas 2 and 7 and all supplies in area 3 were lightly forked round and mulched with green material.

A few casualties have occurred in areas 2 and 7.

In area 6 (the earliest planted area of foreign clones) at present every hole contains a growing tree.

T. H. HOLLAND,
Manager,
Experiment Station,
Peradeniya.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MARCH, 1931

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1931	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	173	66	37	107	20	9
	Foot-and-mouth disease	216	167	203	2	10	1
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	2*	...	...	...	...	2
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	195	45	155	6	32	...
	Anthrax (Sheep & Goats)	9	2	...	9	...	...
	Rabies	2	..	...	...	...	2
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	
Cattle Quarantine Station	Rinderpest	.	...	...	...	...	...
	Foot-and-mouth disease	...	..	...	...	...	...
	Anthrax	79	25	...	79	...	...
Central	Rinderpest	...	..	...	..	...	...
	Foot-and-mouth disease	14	...	14	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	6	...	...	..	...	6
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	1032	28	870	5	157	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	..	...	...	
Northern	Rinderpest Foot-and-mouth disease Anthrax Black Quarter Rabies (Dogs)	FREE					
Eastern	Rinderpest Foot-and-mouth disease Anthrax	FREE					
North-Western	Rinderpest	3955	1129	74	3361	54	466
	Foot-and-mouth disease	...	...	...	...	. .	...
	Anthrax	...	...	...	..	...	...
	Pleuro-Pneumonia (in Goats)	...	...	...	...	...	...
North-Central	Rinderpest	1899	471	241	1569	81	8
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	1	...	1	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Sabaragamuwa	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	..	...	...	...	...	...
	Rabies (Dogs)	1	...	...	...	...	1
	Piroplasmosis	1	...	1	...	...	...
	Haemerrhagic Septicaemia	5	...	...	5	...	...

* 1 case in a cow.

G. V. S. Office,
Colombo, 10th April, 1931.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT

MARCH, 1931

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo	89·4	+ 1·4	75·0	+ 1·6	69	93	4·2	1·86	9	- 2·86
Puttalam	91·1	+ 2·3	73·2	+ 0·8	67	93	2·2	3·56	4	+ 0·59
Mannar	91·7	+ 1·7	74·5	- 0·2	63	90	1·4	0	0	- 1·48
Jaffna	89·4	+ 1·7	74·9	- 1·2	68	90	3·6	0·45	1	- 0·72
Trincomalee	—	—	—	—	—	—	—	—	—	—
Batticaloa	85·7	+ 0·3	75·2	+ 1·1	76	93	5·1	3·55	6	+ 0·41
Hambantota	88·4	+ 2·1	74·7	+ 1·7	68	88	3·7	0·23	3	- 2·35
Galle	88·6	+ 2·6	75·5	+ 0·3	72	88	4·6	2·05	9	- 2·69
Ratnapura	93·8	+ 3·7	73·0	- 0·2	67	93	2·9	5·95	18	- 3·05
A'pura	93·7	+ 2·8	72·9	+ 1·3	56	83	5·9	1·39	3	- 1·57
Kurunegala	95·9	+ 3·0	73·0	+ 1·1	54	90	4·9	1·71	4	- 3·53
Kandy	90·0	+ 3·2	69·5	+ 1·3	66	87	3·4	4·82	8	+ 0·63
Badulla	83·0	+ 0·6	65·1	+ 1·6	72	97	4·0	2·17	7	- 2·50
Diyatalawa	79·2	+ 2·9	58·2	+ 0·4	60	85	4·4	3·88	5	- 0·49
Hakgala	75·2	+ 1·8	53·2	+ 1·7	66	82	3·8	6·01	4	+ 0·45
N'Eliya	72·3	+ 1·3	45·5	- 0·1	63	93	3·8	3·10	4	- 0·41

At the great majority of stations the rainfall of March was deficient, a fact which was emphasised by cumulative effect after a dry February. Such rain as did occur fell chiefly between the 5th and 14th, and was largely of the local thunderstorm type, while hail was reported on the 9th south-west of Ratnapura, *e.g.*, in the Kukul Korale.

The areas in which the total for the month were above 5 inches comprised Sabaragamuwa and extended southward to include the extreme south of the W.P., and most of the western half of the S.P. It also extended eastward to include most of Dimbula and Dickoya and thence along the southern limit of the hills to Koslanda and Poonagalla. The highest totals were at Geekiyanakanda and West Haputale, each of which reported 12·73 inches. Comparatively few stations passed their average, those that did so being chiefly in the south-west quarter of the C.P. and in the S.P., though there were a few in the N.W.P.

The smallness of the averages prevented any great deficits in the north and east, but several stations in the N.P., N.C.P., and northern part of the E.P. recorded no rain at all, and hence were in deficit by the amount of their averages.

As will be seen in the table above, temperatures were pretty consistently above average.

The duration of bright sunshine was appreciably above average, while humidity and amount of cloud were both in deficit.

A. J. BAMFORD,
Superintendent, Observatory.